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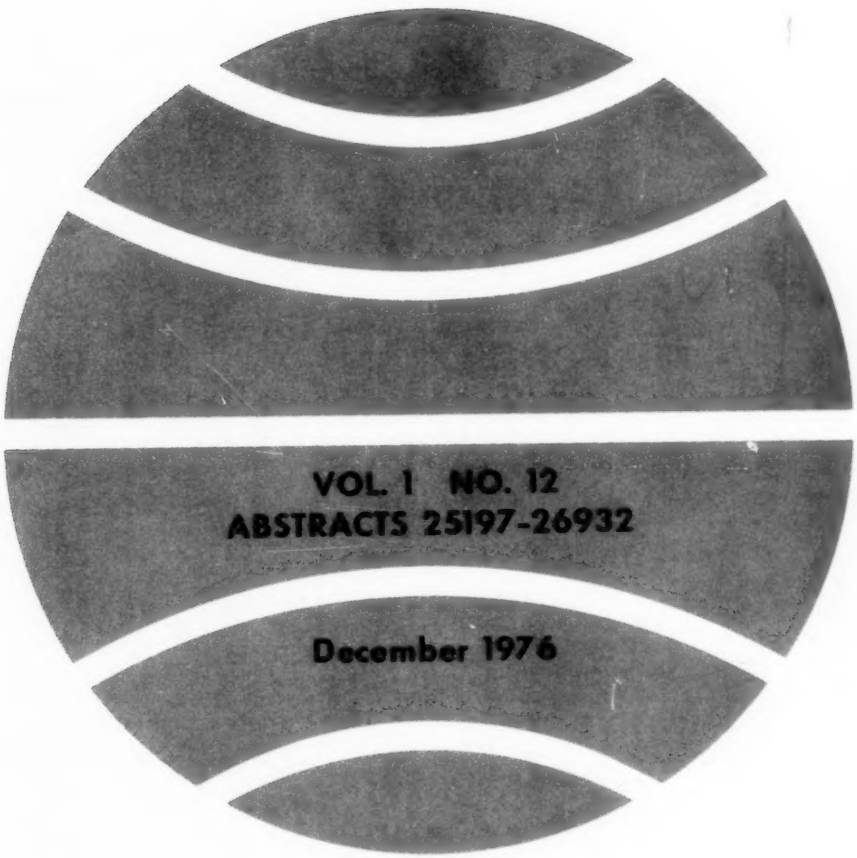

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SCOTT, C.D., See JOLLEY, R.L., 75:847
SCOTTI, L.J., See HAMSHAR, J.A., 75:705

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COAL GASIFICATION
  See also COED PROCESS
  SYNTHANE PROCESS
COAL GASIFICATION/BI-GAS PROCESS
  Environmental aspects of the BI-GAS process (Reactive components in coal are completely used in process, and ash for disposal is in form of granular, vitreous slag), 75:715 (EPA-650/2-74-118)

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is indexed as:

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TEXTRON, INC., SYLMAR, CALIF. (USA). SPECTROLAB DIV.
  Terrestrial photovoltaic power systems with sunlight concentration. Quarterly porgress report, July 1, 1974--September 30, 1974, 75:00737 (NSF-RA/N--74-129)
THERMO ELECTRON CORP., WALTHAM, MASS. (USA)
  Advanced thermionic technology, FY1975. Progress report number 4, October 1974, 75:00821 (TE--4190-57-75)
TYCO LABS., INC., WALTHAM, MASS. (USA)
  Continuous silicon solar cells. Third quarter progress report, July 1, 1974--September 30, 1974, 75:00742 (NSF-RA/N--74-139)
  Scale-up of program on continuous silicon solar cells. Semiannual progress report, May 1, 1974--June 30, 1974, 75:00735 (NSF-RA/N--74-089)

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Volume 1, Number 12, December 1976

ERDA ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 25912, 25913, 25941, 25942, 25953, 25987

25197 (ERDA—76-10) **Fossil energy program report, 1975—1976.** Seamans, R.C. Jr.; White, P.C. (Energy Research and Development Administration, Washington, D.C. (USA)). 1976. 384p. Dep. NTIS $10.75.

The newly created Energy Research and Development Administration greatly expanded its horizons for Fossil Energy technology in 1975-76, especially in moving toward large demonstration projects for converting coal to clean fuels. Significant progress was achieved in developing the Fossil Energy research program, notably the enlistment of universities, and in securing industry participation in cost-sharing projects for the enhanced recovery of petroleum and natural gas. ERDA, established January 19, 1975, inherited the coal, petroleum, natural gas, and oil shale programs that principally orginated in the Department of the Interior's Office of Coal Research and the Bureau of Mines. The conversion and utilization of coal, the Nation's most abundant fossil fuel, was given high priority in ERDA's National Energy Plan announced June 30, 1975. Light water nuclear reactors and the enhanced recovery of oil and gas were also ranked as fuel sources that can bridge the energy gap between now and the year 2000. After that, ERDA foresees the successful development of more inexhaustible supplies of energy, such as the breeder reactor, solar electric, and fusion. Individual programs are described briefly.

25198 (ORNL/TM—5532) **Coal technology program progress report for May 1976.** (Oak Ridge National Lab., Tenn. (USA)). Jun 1976. Contract W-7405-eng-26. 25p. Dep. NTIS $4.00.

In the Hydrocarbonization project, two successful experiments were completed in the bench-scale hydrocarbonizer. In the Solids-Liquid Separations project, initial filtration runs on the bench-scale filter employed a 40-μ metal disc filter. Filtration rates for PAMCO-SRC at 500°F were as high as 165 lb/hr . ft^2, but decreased rapidly with cake thickness. High-temperature pyrolysis studies of large coal blocks were significantly interrupted by equipment problems which developed. Several tests at 800°C were completed, however, with the continued production of pyrophoric chars at external heating rates of 0.3 and 3.0°C/min. Samples of Synthoil, shale oil, crude petroleum, and by-product waters from oil shale retorting and Synthane coal gasification have been chemically fractionated and are being examined for biological activity. Normal alkanes in oil shale and by-product retort water have been determined. Polycyclic aromatic hydrocarbon (PAH) fractions have been prepared from extracted organics removed from shale oil by-product water and Synthane condensate water. In the conceptual design study of the Synthoil process, preliminary figures indicate that the overall capital cost estimate for the commercial-scale (100,000 bbl/day) plant will be in the neighborhood of $2 billion. Work continued on the estimation of operating costs. In the Hydrocarbonization conceptual design study, the major effort was placed upon capital and operating cost estimation. In Coal-Fueled MIUS, because of excellent progress in preparation of tube bundle drawings and specifications, it was decided to hold the furnace housing bid request in order to send out a combined furnace and tube bundle bid package.

PROCESSING

25199 Division of Fuel Chemistry 164th national meeting of the American Chemical society, New York, New York, August 27—September 1, 1972. Schlesinger, M.D.; Wiser, W.H. Ann Arbor, MI; Xerox University Microfilms (1976). 115p. (CONF-720821—P1). $3.00.

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

Separate abstracts were prepared for nine papers on fuel processing, the energy situation, and its environmental impact. (JSR)

CARBONIZATION

25200 Economics of coke oven charging controls. Kertcher, L.F.; Linsky, B. *J. Air Pollut. Control Assoc.*; **24**: No. 8, 765-771(Aug 1974).

A study was undertaken to determine which of several alternative air pollution abatement systems affords the most economical solution to the control of atmospheric emissions during the charging of coal into by-product coke ovens. The study was limited to the consideration of existing by product batteries, and the assumption was made that no coking plant has the alternative to do nothing nor will the plant choose to delay abatement through legal procedures. The data indicate that a jumper pipe installation with a new Larry Car provides the most economical control method for retrofitting coke oven batteries.

25201 Method of pyrolysis of coal in situ. Terry, R.C. (to In Situ Tech., Inc.). US Patent 3,924,680. 9 Dec 1975. Filed date 23 Apr 1975. 8p.

A method of pyrolysis of coal in-situ includes the steps of establishing a pair of passages between a subsurface coal formation and the surface with the passages being adapted to separately remove liquids and gases from the coal formation, establishing a sump at the bottom of the passages which extends at least partially below the coal formation to receive liquid volatile material released from the formation, and heating the coal formation so that initially tars in the formation will migrate radially until they go eyond the heated area whereupon they will solidify and form a hermetic barrier around the zone to be pyrolyzed to confine gaseous and liquid volatile materials released from the coal as a result of the pyrolysis. The released gaseous materials can then flow to the surface through one of the passages and the liquid volatile material can flow into the sump and be pumped to the surface through the other passage.

25202 Low-sulfur fuel by pressurized entrainment carbonization of coal. Belt, R.J.; Roder, M.M. (Morgantown Energy Research Center, WV). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **17**: No. 2, 82-92(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P2.

An empirical approach that included mathematical models proved useful in predicting the yields and chemical properties of chars produced by pressurized entrainment carbonization of coal over a range of operating conditions. Carbonization runs were carried out according to a composite factorial design covering temperature, pressure, and entraining gas composition. The mathematical models indicate that char containing 0.7 percent sulfur or 0.49 pounds per million Btu could be produced from coal contain-

ing 2.5 percent sulfur at 1,900°F, 400 psig, and an entraining gas containing 91 percent hydrogen and 9 percent nitrogen. Temperature, pressure, and hydrogen content of the entraining gas all influenced the total and organic sulfur content of the char and the sulfur content per unit heating value; only temperature and pressure affected the pyritic sulfur content of the char. Sulfate sulfur was unaffected by any of the three variables. Volatile matter content of the char decreased with increase in carbonization temperature, as would be expected, but was unaffected by pressure and entraining gas composition.

25203 Apparatus for the carbonization of coal. Hinkley, D.W. (to International Oils Exploration NL). US Patent 3,966,561. 29 Jun 1976. Filed date 23 Sep 1974. 6p.

Carbonization of coal occurs in a traveling grate furnace with hot gas inlets below the grate. A refractory screen is provided above the grate to provide a flame propagation base for the volatile gases withdrawn from the coal on the grate. The combustion zone above the refractory screen provides radiant heat to vaporize volatiles present in the coal on the grate. The coal to be treated may be in the form of briquettes or an extruded slab. When an extruded slab of slurried coal is used the thermal shock on first entering the carbonization chamber results in the formation of carbon granules.

25204 Manufacture of coke from a coal extract. Gray, M.D.; Kimber, G.M.; Shipley, D.E. (to Coal Industry (Patents) Ltd.). US Patent 3,966,585. 29 Jun 1976. Priority date 30 Nov 1973, United Kingdom of Great Britain and Northern Ireland (UK). 10p.

The invention relates to a process for the production of coke having a low mineral matter content, which process comprises digesting coal in a high boiling aromatic oil solvent at a temperature within the range of 350°C to 480°C., separating insoluble matter from the coal digest to give a coal extract and coking the coal extract.

25205 Improvements in and relating to the production of coke. Gray, M.D.; Kimber, G.M. (to Coal Industry (Patents) Ltd.). US Patent 3,966,584. 29 Jun 1976. Priority date 12 Dec 1973, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A process is described for the production of coke which comprises extracting coal at an elevated temperature with a suitable solvent, filtering undissolved material from the extract, concentrating the extract and thereafter coking the concentrated extract while recovering the solvent for recirculation characterised in that prior to digestion of the coal the solvent is subjected to coking under conditions comparable with the conditions under which the coal solution is subjected to coking until coking of all the cokable components in the solvent is substantially complete.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 25231, 25240

25206 (FE—496-115) **Solvent Refined Coal (SRC) process. Annual report, 1975.** (Pittsburg and Midway Coal Mining Co., Kansas City, Mo. (USA)). Mar 1976. Contract E(49-18)-496. 65p. Dep. NTIS $4.50.

The Ft. Lewis SRC Process Pilot Plant completed "Start up" operations after a total of 16 material balance runs. Five material balance runs were made in the new SRC II or slurry recycle mode for the production of liquid rather than solid SRC. In September the Pilot Plant began the Combustion Test-Production Run to produce 3000 tons of low-sulfur, low-ash SRC for testing in a commercial electrical generating facility. All units within the plant with the exception of the prilling tower have been tested and successfully operated. This was not, however, possible without making extensive modifications, particularly in the Mineral Separation (Filtration) Area and Fractionation Area. Development efforts at the SRC Laboratory in Merriam, Kansas, continued to be directed toward the SRC II process. Slurry recycle runs were made at various operating conditions and using different coals. Special studies designed for Ft. Lewis operations were also made. SRC I runs were conducted in the lab at conditions used in the SRC Pilot Plants at both Ft. Lewis and Wilsonville. Supporting research at Washington State University on the recovery of iron from the SRC mineral residue via gasification continued through 1975, but at a slower pace than in past years. The Nuclear Radiation Center at Washington State, completed all preliminary work for trace element determination by neutron activation analysis.

25207 (FE—2033-10) **Hot low Btu producer gas desulfurization in fixed bed of iron oxide-fly ash. Monthly report No. 9, 1 March—31 March 1976. Quarterly report No. 3, 1 January—31 March 1976.** Leuenberger, E.L. (Air Products and Chemicals, Inc., Marcus Hook, Pa. (USA)). 17 May 1976. Contract E(49-18)-2033. 57p. Dep. NTIS $4.50.

Major emphasis in this period has been in the preparation, and dynamic absorption testing of experimental sorbents. The studies of physical properties and chemical analyses of the prepared sorbents, a method for analyzing dynamic test data is explained and the effects of the following variables on sorption dynamics are presented: Sorbent iron oxide content, GHSV at constant linear velocity (GHSV = bed gas hourly space rates (SCFH/ft^3 bed), linear velocity at constant GHSV, temperature, pressure, sorbent particle size, and producer gas H_2S content. The dynamic test data indicate that optimum sorbent performance is obtained at 42 percent by weight iron oxide. The effect of GHSV at constant velocity provides a basis for an empirical sorption dynamics model. A significant effect of bed geometry on sorbent performance was discovered. Test results indicate the sorbent will totally disintegrate when exposed to sulfur-free producer gas at 900°F. At a given GHSV, the best sorbent performance is observed at high pressure, high linear velocity, and small sorbent particle size. Two isothermal sorption models derived from fundamental principles and the empirical model are compared with dynamic test results. The empirical model was superior.

25208 (PB—241878) **Removal of hydrogen sulfide from hot producer gas by solid absorbents. Research report.** Abel, W.T.; Shultz, F.G.; Langdon, P.F. (Bureau of Mines, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Dec 1974. 30p. (BM-RI—7947). NTIS $3.75.

Previously announced as N—74-31591.

Forty-eight materials were tested for their ability to absorb H_2S from hot simulated producer gas (1,000 - 1,300°F). The material found best from the standpoint of absorption capacity, durability, and amendability to regeneration was sintered pellets of 75% fly ash - 25% Fe_2O_3. The performance of this absorbent under simulated and actual conditions are described in this paper. The effect of absorbent composition, absorbent temperature, steam content of the gas and tar vapors and dust in producer gas are discussed. (GRA)

25209 Method for treating coke oven gas. Tatterson, B.F. (to Koppers Co., Inc.). US Patent 3,798,308. 19 Mar 1974. Filed date 19 Jan 1972. 5p.

An improvement in a process for converting hydrogen sulfide to sulfur associated with coke oven gas by-product recovery systems is described which eliminates or at least minimizes the requirements of tail gas incineration required for elimination of sulfur-containing gases such as sulfur dioxide from present Claus type processes. The tail gas is combined with crude coke oven gas in the gas by-product recovery system, and the SO_2 and other sulfur-containing gases react with the coke oven gas components or with components of the solutions employed in various phases of the by-product recovery system and are removed from the combined gases or pass through the recovery system unchanged for eventual burning or venting to the atmosphere in less objectionable concentrations.

25210 Removal of pyritic sulfur from coal. Meyers, R.A. (to TRW Inc.). US Patent 3,926,575. 16 Dec 1975. Filed date 19 Jul 1971. 4p.

Finely divided coal or coal derivatives, containing pyrite, are reacted with sulfurous acid (the oxidizing agent); if desired, HCl may also be used to improve the reaction efficiency to remove pyritic sulfur from coal as shown by equations given. The solution containing ferrous chloride and unreacted sulfurous acid is then filtered from the coal which is then washed and heat dried under low pressure. Most of the free sulfur is volatized from the coal due to the heat drying; additional free sulfur can be removed by additional washing and heat drying and/or solvent extraction techniques. If desired, the ferrous chloride can be oxidized to ferric oxide and hydrochloric acid. The hydrochloric acid may be recycled and the iron oxide used for production of steel or discarded.

25211 High field-high gradient magnetic separation: a review. Luborsky, F.E. (General Electric Corporate Research and Development, Schenectady, NY). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 29, 633-638(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Magnetic separation technology was given new impetus with the introduction of a separator using a matrix of steel wool in a high field combined with an efficient magnetic circuit for the electromagnet. This technology is economically attractive for a wide variety of new separations. The development and status of these applications are briefly reviewed. This commercial interest stimulated theoretical interest to develop mathematical descriptions of the separation process. The status of the theoretical calculations is reviewed and their predictions compared to available experimental

work. Limitations of the present calculations, and the future directions of the modeling work, are discussed. 8 fig., 64 references.

25212 Synthetic fuel gas purification by the SELEXOL process. Sweny, J.W. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 2, 142-156(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

There are a large number of commercial processes available today for purifying natural, synthesis, and synthetic gases containing acid gases and other impurities. Quite recently a new family of solvents and processes has appeared offering technical and economic improvements. Known as physical solvents, their use allows for more freedom and versatility of design than that found with the more conventional chemical processes. Based upon well known physical and thermodynamic concepts, proven applications have allowed for the development of improved design methods.

25213 Preparation of ash-free, pyrite-free coal by mild chemical treatment. Reggel, L.; Raymond, R.; Wender, I.; Blaustein, B.D.;. (Bureau of Mines, Pittsburgh). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 1, 44-48(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P1.

Treatment of certain bituminous coals with 10 percent aqueous sodium hydroxide at 225°C removes essentially all of the inorganic sulfur (sulfate and pyritic sulfur). Proper treatment of the coal with acid (after the alkali treatment) removes almost all of the mineral matter. With some coals, the product contains only 0.5 percent ash and 0.2 percent pyrite. Waste sulfuric acid or sulfur dioxide can be used for the acidification. It may be possible to recover mineral constituents of value. Ash-free coal might be valuable for gasification to produce synthetic high-Btu gas; for combustion to generate electricity, either in conventional steam plants or in MHD generators; for improved catalyst life in catalytic hydrodesulfurization of coal; it may give greater yields and a higher quality product in conventional coal hydrogenation. Combination of the deashing, depyriting procedure with a method for removal of organic sulfur from coal is also being studied. This would yield a nonpolluting fuel and help greatly in the related problems of needs for energy and need for a cleaner environment.

25214 Division of Fuel Chemistry 164th national meeting of the American Chemical Society, New York, New York, August 27—September 1, 1972. Schlesinger, M.D.; Wiser, W.H. Ann Arbor, MI; Xerox University Microfilms (1976). 128p. (CONF-720821—P2).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

Separate abstracts were prepared for eight papers on the removal of S from fuels and of S and N from combustion products. (JSR)

25215 Chemical removal of pyritic sulfur from coal. Hamersma, J.W.; Kraft, M.L.; Koutsoukos, E.P.; Meyers, R.A. (TRW Systems Group, Redondo Beach, CA). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 2, 1-14(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P2.

A new approach for the chemical removal of pyritic sulfur from coal is described. The process is based on the discovery that aqueous ferric salt selectively oxidizes the pyritic sulfur in coal to chemical forms which can be removed by vaporization, steam, or solvent extraction. Data for removal of the pyritic sulfur from four major coals (Lower Kittanning, Illinois No. 5, Herrin No. 6, and Pittsburgh) are presented together with a detailed discussion of the process chemistry. The effect of variables, such as coal particle size, acid and iron concentration, reaction time and temperature among others, are discussed. The results show that near complete removal of pyritic sulfur can be obtained under mild conditions, resulting in a reduction of the total sulfur content of the coals from 40 to 80 percent, depending on the original pyritic sulfur content. The current development effort is being accomplished under support from the Environmental Protection Agency, Division of Control Systems.

25216 Production of low sulfur fuel oils from Utah coals. Qader, S.A.; Hill, G.R. (Univ. of Utah, Salt Lake City). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 2, 37-42(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P2.

Utah coals with varying sulfur contents were hydrogenated and the distribution of sulfur in the products was determined. Most of the sulfur was transferred into the coal oil. The coal oil and its fractions were refined in fixed and ebulating bed reactors to reduce the sulfur content down to 0.1 percent. The efficiencies and selectivities of the reactor systems were evaluated. The economics of producing low-sulfur fuel oils from coal were presented.

25217 Catalyst aging in a process for liquefaction and hydrodesulfurization of coal. Stanulonis, J.J.; Gates, B.C.; Olson, J.H. (Univ. of Delaware, Newark). *AIChE (Am. Inst. Chem. Eng.) J.;* **22**: No. 3, 576-581(May 1976).

Aged $CoO/MoO_3/SiO_2/Al_2O_3$ catalyst pellets were analyzed with an electron microprobe and scanning electron microscope. Pellets of the hydroprocessing catalyst used in the Synthoil process (sulfided $CoO/MoO_3/SiO_2/Al_2O_3$) accumulated inorganic and organic contaminants both on the exterior surface and in the pore mouths. The inorganic (carbon free) deposit found in the upstream end of the fixed-bed reactor has been identified as primarily ferrous sulfide, $Fe_{14}S_{15}$. This material covered 50 to 70 percent of the catalyst's peripheral surface and penetrated into the catalyst pores to a depth of about 100 μm. The total accumulated deposit caused a 70 percent reduction in catalyst surface area and pore volume. The inorganic deposit found in the downstream end of the reactor was mainly aluminum and silicon and covered 10 to 20 percent of the catalyst's peripheral surface. Titanium penetrated about 150 μm into the pores. All of these deposits caused a 40 percent loss of pore volume. These results imply that deposition in coal hydroprocessing reactors could lead to bed plugging and pore mouth blocking.

HYDROGENATION

REFER ALSO TO CITATION(S) 25216, 25233, 25234, 25239, 25252

25218 Catalytic activity of coal hydrogenation catalysts. Matsuura, K.; Bodily, D.M.; Wiser, W.H. (Univ. of Utah, Salt Lake City). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 2, 227-230(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

The catalytic properties of catalysts that are active in a short-residence time coal hydrogenation reactor are discussed. Zinc halides and stannous chloride are found to be among the most active of a large number of catalysts tested. Surface acidities are determined by titration with amine bases. The acidity of these catalysts and of coals impregnated with these catalysts are compared with those of catalysts active in long-residence time batch coal-hydrogenation experiments and in other hydrogenation reactions. The activity of these catalysts in other chemical reactions are discussed in terms of their activity in coal hydrogenation.

25219 Coal hydrogenation in small tube reactors. Wood, R.E.; Hill, G.R. (Univ. of Utah, Salt Lake City). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 1, 28-36(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P1.

The hydrogenation conversion of coal to liquid and gaseous fuels has been attempted in almost every conceivable fashion. One recent development has been the use of small tube reactors where coal, conveyed by a rapidly moving stream of hydrogen is passed through a heated and pressurized zone. Tests have shown that coal conversion in the 70 percent range can be attained in a $^1/_8$-in.-I.D. tube reactor. It is essential that gas velocities be great enough to cause turbulent flow in order to prevent sticking and plugging of the tube. Residence times within the reactor are of the order of a few tenths of a second to a few seconds. Impregnated salt catalysts of the zinc halide type are most effective. Process variables such as coal type, catalyst, coal feed rate, pressure, temperature, hydrogen flow rate and particle size are discussed.

GASIFICATION

REFER ALSO TO CITATION(S) 25261, 25292, 25293, 25383, 25513, 25519, 25694, 25958, 26117

25220 (CONF-750329—4) **Comparison of results from underground coal gasification and from a stirred-bed producer.** Fischer, D.D.; Schrider, L.A. (Energy Research and Development Administration, Laramie, Wyo. (USA). Laramie Energy Research Center). 1975. 28p. Dep. NTIS $4.00.

From American Institute of Chemical Engineers meeting; Houston, Texas, USA (16 Mar 1975).

In the fall of 1972, the Bureau of Mines began an experiment to investigate underground gasification of a western subbituminous coal. The gasification site is near the town of Hanna, Wyoming, approximately 70 miles northwest of Laramie. Gas production rates have fluctuated from 50,000 to over 3 million standard cubic feet per day with a heating value from 30 to 465 Btu per standard cubic foot. Even though fluctuations have occurred, a semi-steady state condition existed for a 5 1/2-month period during which a low-Btu gas averaging about 130 Btu per standard cubic foot was produced at an average rate of 1.6 million standard cubic feet per day on a dry basis. A material balance made during this period indicated (1) there was little or no underground gas leakage from the site, (2) about 80 barrels of groundwater were removed from the system each day, (3) between 13 and 46 tons of dry coal were affected each day depending upon the assumptions made, and (4) from 23 to 65 percent of the latent energy of the coal being subjected to carbonization and/or gasification was recovered in the dry product gas. Comparison of these results with data obtained from gasification of various coals in a stirred-bed producer tends to substantiate that in situ coal gasification could supplement aboveground gasification systems. (auth)

25221 (CONF-760906—5) **Recovery of inaccessible coal reserves by in situ gasification.** Forrester, R.C. III. (Oak Ridge National Lab., Tenn. (USA)). 1976. Contract W-7405-eng-26. 17p. Dep. NTIS $3.50.

From 11. intersociety energy conversion engineering conference; State Line, Nevada, United States of America (USA) (12 Sep 1976).

In-situ gasification of coal offers the possibility of providing a much-needed energy option for the United States and of greatly expanding our available resource reserve. Preliminary experiments suggest that costs will be competitive with those for surface processing techniques and that new technology requirements are not unachievable. These factors, coupled with reduced environmental impacts and associated prospects for improved occupational health and safety, are probably sufficient to ultimately assure proven UCG technology a large share of society's overall energy demand. Increasing commitment by government and industry to the development of this technology is a promising new light for what, at present, appears to be a rather dark energy future.

25222 (FE—1207-P17) **BI-GAS pilot plant program. Interim report, January—March 1976.** Hull, D.E. (Phillips Petroleum Co., Homer City, Pa. (USA)). Apr 1976. Contract E(49-18)-1207. 15p. Dep. NTIS $3.50.

With 51 of the 55 Homer City BI-GAS pilot plant systems provisionally accepted, the startup and checkout activities moved at a rapid pace. Startup and checkout of the gasifier cooling system, the slag lockhopper system, and the recycle gas compressor was in progress at the end of March. The high pressure boiler was being boiled out. The instrument department has been calibrating and commissioning instrumentation for the fuel oil, fuel gas, demineralizer, low pressure boiler, high pressure boiler, flux grinding, coal grinding, coal flash drying, sulfur recovery and nitrogen systems. The laboratory is continuing to receive and calibrate equipment and to complete its staff while providing critical service to operations during startup. Samples of the Rosebud coal were tested for moisture, volatile matter, carbon, hydrogen, ash, calorific value, nitrogen, sulfur, and sulfur forms. Work on ash composition of the coal samples is continuing. The atomic absorption apparatus is being set up to aid in the determination of the ash composition of the coal. Coal slurry densities and sieve analyses have been obtained for the coal grinding operation. Sieve analyses have been run on the ground flux from the flux grinding system. The laboratory continues to monitor the cooling tower water, instrument air dew point, demineralizer water, boiler feedwater, boiler water blowdown, and pond effluent.

25223 (FE—1505-7) **Liquid phase methanation. Quarterly report, January 1, 1976—March 31, 1976.** (Chem Systems, Inc., New York (USA)). 1976. Contract E(49-18)-1505. 30p. Dep. NTIS $4.00.

A 760 hour run in the life test unit was completed using a Calsicat Ni-230S catalyst and Witco 40 mineral oil. The feed gas contained a H_2/CO ratio of 1.4/1. The catalyst activity stabilized at a value somewhat higher than that obtained in a previous run with the same catalyst. The two polishing reactors completed their scheduled 1000 hour runs. The catalyst was removed and returned to the catalyst supplier for detailed analysis and evaluation. The PDU was checked out and started up. The first system investigated was a $2H_2$/1CO feed gas with the Calsicat Ni-230S/Witco 40 mineral oil system. A complete process variable scan was completed and the results were entirely consistent with previous work in both the bench scale and process development units. A second process variable scan has been started using a 1.5 H_2/1CO feed gas with the Calsicat Ni-230S/Witco 40 mineral oil system. Radiographic inspection of all piping butt welds on the LPM pilot plant was completed. Approximately 40% of the welds were classified as defects under the 100% X-ray examination criteria. The conditions of the LPM/S polishing reactor design were compared with other commercial (SNG naphtha gasification plants) and proposed (RMP Process) final stage methanators. All systems lie outside the carbon forming region.

25224 (FE—1772-16) **Engineering support services. Clean boiler fuel demonstration plant. Quarterly technical progress report, January 1, 1976—March 31, 1976.** (Dravo Corp., Pittsburgh, Pa. (USA). Chemical Plants Div.). 15 Apr 1976. Contract E(49-18)-1772. 16p. Dep. NTIS $3.50.

Engineering support services provided to ERDA are described: analysis of plant effluent streams, reporting of unacceptable environmental effects and recommendations for correction; preparation of conceptual commercial plant design based on process used by Coalcon, including a feasibility study; evaluation of all available gasifiers and off-gas clean-up systems, including preparation of a handbook with information on each; and various engineering, review and evaluation tasks as requested by ERDA. (LTN)

25225 (FE—1790-4) **Alloy catalysts with monolith supports for methanation of coal-derived gases, phase 1. Annual technical progress report, April 22, 1975—April 22, 1976.** Bartholomew, C.H. (Brigham Young Univ., Provo, Utah (USA)). 6 May 1976. Contract E(49-18)-1790. 91p. Dep. NTIS $5.00.

Accomplishments are reported for the first year of investigation of new pellet- and monolithic-supported alloy catalysts for methanation of coal synthesis gas. Hydrogen and carbon monoxide adsorption data were obtained for alumina-supported nickel, ruthenium, alloys of ruthenium with palladium and cobalt, and alloys of nickel with ruthenium, rhodium, molybdenum oxide, iron, cobalt, platinum, and palladium before and after exposure to low concentrations of hydrogen sulfide in hydrogen. Chemical analysis and x-ray diffraction measurements were made for selected samples. Design and construction of a high pressure laboratory reactor for catalyst testing was completed and all of the nickel containing catalysts were screened for methanation activity at 225 and 250°C and 1 atm.

25226 (FE—2006-2) **Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, October —December 1975.** (Utah Univ., Salt Lake City (USA). Dept. of Mining, Metallurgical and Fuels Engineering). Mar 1976. Contract E(49-18)-2006. 79p. Dep. NTIS $5.00.

The research reported is of fundamental importance in support of either a process for development of liquefaction of coal, catalysis or some related research. The information which will be gained by research on this contract should materially assist the application of coal in the solution of the energy problems now facing the United States and the world. In particular, the projects reported herein are intended to apply the expertise developed by the coal research team at the University of Utah to problems in four general areas: evaluation of process concepts in relation to liquefaction and gasification of coal; catalysis studies of fundamental importance in liquefaction and gasification of coal; studies of fundamental principles involved in processes for liquefaction and gasification of coal; and properties of coal and coal conversion products of significance in liquefaction and gasification of coal. ESCA (Electron Spectroscopy for Chemical Analysis) techniques were used to study the reactions of $ZnCl_2$ hydrogenation catalyst with coal. Evidence for a chemical reaction between catalyst and coal was obtained. The reaction occurs at low temperatures and alters the binding energy of valence electrons in the zinc. This study is expected to provide new information on the mechanism of hydrogenation of coal by $ZnCl_2$. Studies of two-stage gasification have been extended to the second stage and show promise of high methane yields.

25227 (FE—2229-1) **Surface structure and mechanisms of gasification catalyst deactivation. Quarterly report, February—April 1976.** Reucroft, P.J.; Bradley, E.B.; De Angelis, R.J.; Sargent, G.A. (Kentucky Univ., Lexington (USA)). Jun 1976. Contract E(49-18)-2229. 41p. Dep. NTIS $4.00.

The objective is to characterize the surface structure of methanation catalysts in order to relate structural features to catalytic activity and catalyst deactivation. Surfaces to be examined in-

clude single crystal nickel with well-defined crystal planes and dispersed samples of nickel and nickel alloys on alumina and silica supports. The validity of currently accepted models of catalyst thermal deactivation e.g., sintering, will be evaluated and assessed for accuracy and applicability. The main effort to date has been directed toward establishing and testing the experimental equipment which will be used. An ESCA spectrometer has been purchased and installed and preliminary results on the surface chemical composition of several catalysts have been obtained. An x-ray diffraction technique for evaluating the average catalyst particle size and particle size distribution has been developed and used to obtain preliminary data on the thermal sintering behavior of several catalysts. Certain other preparatory efforts are described.

25228 (LBL—4498) **Coal char gasification using alkali metal catalysts.** Veraa, M.J.; Bell, A.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1976. Contract W-7405-ENG-48. 105p. Dep. NTIS $5.50.

Thesis.

In order to simplify the experimental procedure and the interpretation of results, coal char rather than coal was used to study steam gasification of a Wyoming sub-bituminous coal with alkali metal salts as catalysts. Coal/catalyst contacting was accomplished by aqueous impregnation of the coal with catalyst. Gasification rates and gas production rates were measured as a function of catalyst type, catalyst loading, and reactor temperature. Steam partial pressure was maintained constant at one half of an atmosphere. Temperature was varied from 600 to 900°C. Initial catalyst screening studies indicated that K_2CO_3 and KOH gave identical results and that both were superior to alkali chlorides in enhancing gasification rates. K_2CO_3 was then used exclusively in all subsequent studies. The following major conclusions can be drawn: Enhancement in the gasification rate results from increased catalyst loading and decreased thermal aging; activation energies decrease with increasing catalyst loading and have values of 39.1, 44.8, and 49.1 Kcal/mole for 10, 5, and 0 percent loadings of potassium, respectively; increasing temperature causes carbon monoxide to be formed in preference to carbon dioxide and hydrogen, and enhances the rate of methane production; and increasing catalyst loading causes carbon monoxide to be formed in preference to carbon dioxide and hydrogen, but diminishes the rate of methane production.

25229 (UCRL—77627) **Numerical model of coal gasification in a packed bed.** Winslow, A.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1976. Contract W-7405-Eng-48. 26p. (CONF-760801—2). Dep. NTIS $3.50.

From 16. international symposium on combustion; Cambridge, Massachusetts, United States of America (USA) (15 Aug 1976).

A one-dimensional, time-dependent computational model has been developed for the simulation of coal gasification in a packed bed, treated as a porous medium. Different gas and solid temperatures are used, and concentrations of eight chemical species (N_2, O_2, H_2O, H_2, CH_4, CO, CO_2, tar), two forms of water (surface and interior), coal and char are followed in space and time. Numerical results obtained for gasification by a mixture of steam and oxygen show reasonable agreement with laboratory measurements. For gasification of a Wyoming subbituminous coal with an oxygen/steam/nitrogen ratio of .134/.844/.022 at a flow rate of 10^{-4} moles/cm²-sec a peak temperature of 1191°K is obtained, a burning speed of 5.2 cm/hr, and moisture-free product composition 48 percent hydrogen, 5 percent methane, 11 percent carbon monoxide and 36 percent carbon dioxide. The numerical method retains all time derivatives and solves the nonlinear partial differential equations by implicit methods which are capable of being extended to two or more space dimensions.

25230 Apparatus for treating a gas current which is obtained by coal gasification. Huetgens, J.; Adomat, G. (to Gutehoffnungshuette Sterkrade Aktiengesellschaft). US Patent 3,925,042. 9 Dec 1975. Priority date 18 Dec 1971, German, Federal Republic of (F.R. Germany). 4p.

A method of treating a gas current which is obtained from coal by gasification comprises compressing the gas in several stages, and prior to the entrance into a subsequent stage, cooling and separating the liquid from at least a portion of the gas and then heating the cooled and separated gas. The apparatus includes a plurality of compression stages with at least one of the stages having connections to a cooler and a water separator through which the gases pass and including a heater for treating at least the portion of the gas which passes through the cooler and separator and which is then delivered into a conduit for transferring all of the removed gas from the previous stage into a subsequent stage.

25231 Production of low Btu gas involving coal pyrolysis and gasification. Wen, C.Y.; Bailie, R.C.; Lin, C.Y.; O'Brien, W.S. (West Virginia Univ., Morgantown). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 1, 36-55(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

One method of reducing or eliminating the sulfur pollution from coal-fed steam production and electrical power generation plants is to convert the coal to a gaseous fuel in which the sulfur compounds, usually existing as hydrogen sulfide, are easier to be removed than are the oxidized sulfur forms. Experiments involving the pyrolysis of bituminous coal, as well as other carbonaceous feed materials, have been performed in an 18-in.-dia, atmospheric fluidized bed. The experimental results from this work indicate that a low-Btu gas (125-250 Btu/cubic foot) can be generated efficiently, using an air feed, in such a low pressure system. This paper analyzes the data from the pyrolysis experiments in order to generate kinetic and heat transfer information and to formulate a coal pyrolysis model useful in the design of commercial-sized processes. The model is then applied in forming a conceptual flowscheme for a relatively low-pressure (7-13 atmospheres) electrical power generation plant. In the conceptual flowscheme, the low-Btu gas is produced in a two-unit pyrolyzer and pyrolysis-char gasifier. The gas is then purified and fed into a combustion chamber, with the electrical power being generated in a combined gas turbine-steam turbine power cycle.

25232 Coal gasification in a low pressure, low residence time, entrained flow reactor. Coates, R.L.; Chen, C.L.; Pope, B.J. (Brigham Young Univ., Provo, Utah). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 1, 165-181(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

A high volatile Utah bituminous coal was finely ground (-200 mesh), entrained in nitrogen or hydrogen, and injected into a 2-inch diameter tubular reactor immediately downstream of a premixed flame of stoichiometric hydrogen and oxygen. The reactor was operated at near atmospheric pressure and the walls were heated to reduce heat losses. The principal test variables were the coal feed rate, which ranged from 0.7 to 2.0 pounds/hour, and the pounds of oxygen fed per pound of coal, which ranged from 0.3 to 1.6. Reactor residence times ranged from 0.06 to 0.3 seconds, and the average reactor temperature ranged from 1300°F to 2240°F. Analysis and metering of the dry product gases showed that a significant fraction of the coal was converted to methane, ethylene and acetylene, in contrast with the low or negligible yields of these gases in conventional low-pressure gasifiers. The yield data were correlated with reactor temperature, residence time, and concentrations of water and hydrogen in the reactor. The variable most strongly governing yield was found to be the temperature. The coal data were found to be consistent with recent BCURA results. The yield of acetylene was found to decrease with increased residence time and increase with increasing temperature. The yield of ethylene was observed to increase with increasing residence time and decrease with increasing temperature.

25233 Pressurized hydrogasification of raw coal in a dilute-phase reactor. Feldmann, H.F.; Mima, J.A.; Yavorsky, P.M. (Bureau of Mines, Pittsburgh). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 1, 182-202(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

Experimental results on the direct conversion of raw bituminous coals to methane by hydrogasification at pressures from 500 to 2,000 psig are presented. The majority of experimental data are for 1,000 to 1,500 psig which probably represents the optimum balance between the high methane concentrations possible at higher pressures and reduced costs at lower pressure. The 3-inch id reactor operated as a free-fall dilute-phase system which allows caking coal to be converted to a noncaking char and methane by reaction with hydrogen. Operating at appropriate gas/coal feed ratios allows the production of a high (70 vol pct) methane gas that is upgradable to pipeline gas with a heating value of 900 or more Btu/scf after methanation of the 4 vol pct CO in the raw product gas. The range of conditions for achieving high-Btu gas are reported as well as the compositions of the product gas and the properties of the char produced. The kinetics of dilute-phase hydrogasification reaction and the application of these data to the design of large-scale dilute-phase reactors for the Hydrane Process are discussed.

25234 Chemistry and physics of entrained coal gasification. Zahradnik, R.L. (National Science Foundation, Washington, DC); Grace, R.J. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 1, 203-227(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

Pulverized coal, when entrained in a stream of hot, hydrogen-containing gas, can be converted in good yields to methane and other combustible gases. Quantitative expressions have been developed, relating the methane yields obtained from this rapid hydrogenation of coal to process variables such as temperature, hydrogen partial pressure, and coal rank. Equally important to the methane yield obtained in entrained coal gasifiers are the mixing patterns established between the coal and hot gas streams. In experiments carried out at BCR using a 100 lb/hr internally fired gasifier, the momentum of the coal feed stream injected into a hot synthesis gas created recirculating flows that reintroduced a portion of the methane, formed in the direct methanation reactions, back into a higher temperature region of the gasifier. There, steam reforming of the methane occurred, with resultant decrease in overall methane production. Although it is difficult to express this loss quantitatively, design objectives for entrained gasifiers are proposed, which should minimize the methane losses due to reforming in secondary flows.

25235 Kinetics of bituminous coal char gasification with gases containing steam and hydrogen. Johnson, J.L. (Inst. of Gas Tech., Chicago). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 1, 228-268(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

A quantitative mathematical model to describe gasification kinetics of bituminous coal chars in gases containing steam and hydrogen was developed based on experimental information obtained over a wide range of conditions. The model is intended for application to two reaction stages: (1) a high-rate methane formation stage corresponding to a limited period after initial exposure of a coal char containing reasonable volatile matter to a gasifying medium containing hydrogen. During this short-lived period, a coal char exhibits an exceptionally high, though transient, reactivity for methane formation. (2) A low-rate gasification stage corresponding to gasification of a char of relatively low reactivity, which results when reaction in the rapid-rate stage is completed. Correlations defining the model developed are presented, and consistencies between predictions of the model and results obtained from a variety of experimental systems is demonstrated.

25236 165th national meeting American Chemical Society, Dallas, Texas, April 8—12, 1973. Division of Fuel Chemistry. Preprints. Volume 18, No. 2. Struck, R.T.; Schora, F.C. Jr. Ann Arbor, MI; Xerox University Microfilms (1976). 250p. (CONF-730403—P2). $3.50.

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

This volume consists of 14 complete papers and abstracts of five additional papers. The complete papers are abstracted and indexed separately. (EJH)

25237 Catalysis of coal gasification at elevated pressure. Haynes, W.P.; Gasior, S.J.; Forney, A.J. (Bureau of Mines, Pittsburgh). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 2, 1-28(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

The effects of additives and catalysts upon the process of coal gasification are discussed for standard bench-scale tests and pilot-plant tests conducted at elevated pressures. Fixed-bed gasification tests conducted at 300 psi and 850°C in the bench-scale unit evaluated about 20 compounds and materials. The results showed that nearly all of the additives tested increased the overall rate of carbon gasification significantly, with alkali metal compounds resulting in the largest increases (over 60 percent). Yields of hydrogen and methane were increased by as much as 105 and 20 percent, respectively. Bench-scale gasification tests at temperatures up to 950°C in the presence of Raney nickel catalysts are discussed. Results of admixing up to 5 percent limestone and hydrated lime in the coal fed to the Synthane fluid-bed gasifier are discussed.

25238 Alkali carbonate and nickel catalysis of coal steam gasification. Willson, W.G.; Sealock, L.J. Jr.; Hoodmaker, F.C.; Hoffman, R.W.; Cox, J.L.; Stinson, D.L. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 2, 29-42(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

Bench-scale investigations are continuing on the NRRI Coal Conversion Process at the Department of Mineral Engineering, University of Wyoming, under the sponsorship of the Office of Coal Research, Department of the Interior. The process uses a multiple catalyst composed of an alkali carbonate and a nickel methanation catalyst in a one-stage batch charge reactor to convert coal and steam to synthetic natural gas. A gas of over 800 Btu/SCF (CO_2 free) composed predominantely of methane has been produced at 650°C and 32 psia. Under these conditions significant improvements on the methane yields are realized by employing the alkali carbonate along with the nickel catalyst. By optimizing the amount of alkali carbonate, the total methane yield can be increased by over 40 percent. The methane yields are discussed in regard to varying amounts of the alkali carbonate. Supporting analytical and x-ray diffraction data are presented.

25239 Catalyzed hydrogasification of coal chars. Gardner, N.; Samuels, E.; Wilks, K. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 2, 43-85(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

The objective is to examine catalysts and catalyst-coal contacting techniques for the hydrogasification of coal and coal chars. In contrast to the wealth of information on catalyzed hydrogenation of coal, and the catalyzed oxidation reactions of carbon by oxygen and carbon dioxide, little is known about catalyzed hydrogasification reactions as to (1) ability of materials to serve as catalysts, (2) kinetics and mechanism of reaction, and (3) physical form of catalyst and contacting techniques. Work on examining various catalysts and methods of contacting catalysts and char particles has been started. The char is being used as a catalyst support, and compounds are being deposited on the char by evaporation, precipitation, and condensation techniques. The kinetic data for various catalyst and char systems and the electron microprobe and scanning microscopy studies will be reported.

25240 Removal of H_2S on oxidized iron. Kertamus, N.J. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 2, 131-140(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

In advanced power cycle concepts involving coal gasification with subsequent second stage combustion, sulfur is gasified and removed as reactive H_2S prior to the second stage combustion. Although several concepts are feasible for H_2S removal, most of these concepts rely on removing H_2S at comparatively low temperatures by a wet scrubbing technique. Because of the desirability of maintaining temperature or the sensible heat in the gas between gasification and combustion, Babcock and Wilcox has studied extensively the high temperature iron - H_2S removal concept. This paper extends previously reported results to temperature from 800 to 1400°F; describes activation of the iron surface for short term tests; discusses an empirical reaction mechanism for H_2S removal and regeneration of the fouled surface; presents results of a life test on the iron absorbent; and describes a potential hardware concept.

25241 Economics of power generation via the Shell gasification process. Halbmeyer, P.J. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 2, 159-180(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

By partial oxidation of high-sulphur residual fuel in the Shell gasification process (SGP), followed by a Shell Sulfinol or ADIP process, a clean low Btu fuel gas is produced. This gas can be used as fuel in a combined-cycle power station where electricity is generated partly in a gas turbine and partly in a steam turbine cycle. The potential high efficiency of such a combined-cycle power station enables the generation of electricity under non-polluting conditions at a price that may well compare favorably with alternative routes of pollution abatement (flue gas or fuel oil desulfurization).

25242 Fluidized-bed coal gasifier as a load-following clean fuel source. Patel, J.G.; Matthews, C.W. (Inst. of Gas Tech., Chicago). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 2, 181-193(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

Coal consumption for the generation of electricity will triple during the next twenty to thirty years. By supplying clean fuel, coal gasification units will control potential coal combustion pollutants for existing fossil plants and for advanced combined power cycles. Many of these plants will supply the swing power demand; nuclear power will fulfill base load requirements; and gas turbines will satisfy peaking loads. Rapid, precise control of fluidized coal gasifi-

cation units is needed when fueling load-following power plants. Operation of gasification units and their turndown is discussed. A yet-to-be-developed process addition is suggested which stores energy during periods of decreased electrical demand for later utilization.

25243 Kinetics of carbon dioxide methanation on a ruthenium catalyst. Lunde, P.J.; Kester, F.L. (United Aircraft Corp., Windsor Locks, CT). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 1, 11-27(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P1.

The kinetics were determined for the methanation of carbon dioxide with hydrogen on a $^1/_2$ percent ruthenium on alumina catalyst: $4H_2(g) + CO_2(g)$ reversible $2H_2O(g) + CH_4(g) + 43$ kcal. Feed ratios (H_2:CO_2) of 2:1 and just under 4:1 were investigated from 200 to 350°C by using partly reacted feed gases to reduce reaction rates as necessary to keep the test reactor isothermal. Sixty-eight tests were conducted using a small ($^1/_2$'' dia. x 1.75''l) reactor filled with commercially available catalyst held at a constant temperature and atmospheric pressure. Chemical analysis was by process gas chromatography. A complete description of the experimental apparatus is given. Theoretical equilibrium compositions for the feed mixture from 200 to 800°C are presented. Data analysis assumed gas-phase type kinetics.

25244 Method of in situ gasification, cooling, and liquefaction of a subsurface coal formation. Terry, R.C. (to In Situ Tech., Inc.). US Patent 3,948,320. 6 Apr 1976. Filed date 14 Mar 1975. 12p.

A method of liquefying a coal formation in situ, wherein the coal formation has been preheated as by a coal gasification project, includes the steps of establishing injection and removal passages connecting the coal formation to the surface, injecting water having a temperature below the formation temperature into the formation to gradually lower the temperature of the formation while forming synthesis gas, injecting a solvent material, having the capability of dissolving the coal, into the formation after it has been reduced to the desired temperature, injecting synthesis gas into the formation to hydrogenate the coal, allowing the formation to subside as the coal is dissolved therein so that more surface area of coal is exposed to the solvent, and removing the admixture of coal and solvent material from the formation as a synthetic crude oil.

25245 Coal gasification process. Hess, M. (to Koppers Co., Inc.). US Patent 3,963,457. 15 Jun 1976. Filed date 8 Nov 1974. 4p.

An improvement in the Koppers—Totzek coal gasification system comprises the step of adding cool and clean recycle gas to the product gas as it leaves the gasifier unit, thereby eliminating the use of water sprays to quench the product gas.

25246 Process for gasifying carbonaceous matter. Hand, J.W. (to Cameron Engineers, Inc.). US Patent 3,963,426. 15 Jun 1976. Filed date 22 Jul 1974. 8p.

A process for the gasification of coal and other carbonaceous materials in which solid particulate carbonaceous material is dried without pyrolysis or oxidation by direct contact with a fluent stream of hot synthesis gas product is described. The dried carbonaceous material is separated from the moist synthesis gas, water is removed from the moist gas and converted to steam, and the steam is mixed with oxygen bearing gas and reacted with the dried carbonaceous material to produce synthesis gas and an ash residue. The oxygen and steam mixture is heated by direct contact with the ash residue, while the hot synthesis gas is utilized to dry the incoming particulate carbonaceous material. Synthesis gas containing hydrogen and carbon oxides is recovered from the process.

25247 Coal treatment process and apparatus. Cramer, F.B. (to Clean Energy Corp.). US Patent 3,966,583. 29 Jun 1976. Filed date 7 Oct 1974. 18p.

A heat transfer-integrated hydrocarbon and heat energy producing system is described for coal treatment or like carbonaceous solid fuel reactant for the co-production of hydrocarbons and heat energy, this system including introducing a single phase molten salt solution of the reactant into a first reaction zone, generating active hydrogen by steam dissociation within the zone, contacting the reactant with the active hydrogen within the first zone and under hydrogenating conditions sufficient to hydrogenate the relatively more reactive 50 to 85 percent by weight portion of the reactant, separating overhead a stream comprising produced hydrocarbons and recovering the hydrocarbons; passing the first reaction zone effluent comprising a molten salt solution of the reactant to a second reaction zone, introducing an oxidizing gas into the solution in the zone under combustion conditions sufficient to substantially completely oxidize the unreacted reactant with the release of heat of combustion into the molten salt, passing combustion gases overhead from the second reaction zone, passing the molten salt second reaction zone effluent after transferring combustion heat therefrom back to the first reaction zone, adding fresh reactant to the effluent and repeating the hydrogenation and combustion cycle.

25248 Solubilization and reaction of coal and like carbonaceous feedstocks to hydrocarbons and apparatus therefor. Cramer, F.B. (to Clean Energy Corp.). US Patent 3,966,582. 29 Jun 1976. Filed date 7 Oct 1974. 18p.

Coal of the subanthracite type and like carbonaceous feedstocks of high molecular weight are soluble in molten inorganic salts while their hydrocarbon vapor hydrogenation products are not. The process and apparatus described utilize these phenomena to effect a hydrogenation of, e.g., bituminous coal in dissolved state in molten inorganic salt with active hydrogen derived in situ from dissociated steam and recovery of hydrocarbon vapor products sequentially evolved throughout the reaction zone by progressively stripping later evolved vapors with earlier evolved vapors passed differentially through the reaction stream thereby driving the hydrogenation reaction forward and collecting the coalesced vapors as product.

25249 Gasification method. Sacks, M.E. (to Cogas Development Co.). US Patent 3,966,634. 29 Jun 1976. Filed date 23 Sep 1974. 8p.

Coal gasification process giving a waste water stream containing phenolic impurities is described. This steam is fed into contact with hot solid heat transfer particles to form superheated steam which is fed to the gasification zone.

25250 Kinetics and catalysis of the reaction of coal char and steam. Kayembe, N.; Pulsifer, A.H. (Iowa State Univ., Ames). *Fuel;* **55**: No. 3, 211-216(Jul 1976).

The kinetics and catalysis of the reaction between steam and two different coal chars were investigated in a small fixed-bed reactor. Atmospheric pressure and temperatures between 600 and 850°C were used. Various possible catalysts were tested, and the effect of catalyst concentration was examined. Of the catalysts used, potassium carbonate was the most effective. It was followed in order of decreasing effectiveness by sodium carbonate, lithium carbonate, potassium chloride, sodium chloride, and copper (II) oxide. Calcium oxide and iron (III) oxide were totally ineffective. The catalysts were more effective at higher concentration. Also, addition of 10 percent potassium carbonate to the coal char lowered the apparent activation energy of the reaction from 254.2 to 144.5 kJ/mol and the frequency factor from 2.41×10^8 to 1.32×10^4 s^{-1}. The water-gas shift reaction reached equilibrium during gasification in the presence of alkali-metal carbonates and the product gas was primarily carbon dioxide and hydrogen. Without catalyst present, the water-gas shift reaction was far from equilibrium.

25251 Synthesis gas manufacture. Seglin, L.; Eddinger, R.T. (to Cogas Development Co.). US Patent 3,968,052. 6 Jul 1976. Filed date 30 May 1974. 6p.

Synthesis gas is prepared by contacting coal-derived char particles with steam in a fluid-bed gasifier wherein heat for the endothermic reaction is supplied by passing through the gasifier a stream of inert pellets heated externally of the gasifier. The pellets, after leaving the gasifier, are separated from entrained char, and then conveyed into a heater where the fines from the external cyclone of the gasifier are burned in the presence of the circulating pellets to produce the heat necessary for the reaction.

LIQUEFACTION

REFER ALSO TO CITATION(S) 25216, 25217, 25226, 25244, 25247, 25248, 25267

25252 (ANL—76-47) **Physical parameters in synthoil process. Quarterly report, January—March 1976.** Fischer, J.; Lo, R.; Nandi, S.; Fredrickson, D.; Javdani, K.; Cannon, T.; Bump, T.; Mulcahey, T.; Huang, H.; Jonke, A. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 34p. Dep. NTIS $4.00.

A development program is being carried out to obtain information applicable to the SYNTHOIL process for converting coal to liquid fuel of low sulfur content. Information is present on the design of apparatus for measuring coefficients of heat transfer from SYNTHOIL process feed and effluent products to process vessel walls, tests on the removal of solids from oil produced in coal liquefaction processes, the design of a test unit for evaluating new catalysts for the SYNTHOIL process, and proposed work on the flow properties and mass transfer characteristics of gas-liquid-solid mixtures during upward transport through a cylinder.

25253 (CONF-760826—2) **Reformation of inorganic particulates suspended in coal-derived liquids and improved separation.** Katz, S.; Rodgers, B.R. (Oak Ridge National Lab., Tenn. (USA)). 1976. Contract W-7405-eng-26. 14p. Dep. NTIS $3.50.

From American Chemical Society meeting; San Francisco, California, United States of America (USA) (29 Aug 1976).

For coal liquefaction processes, the separation of fine inorganic particulates from the organic product matrix represents an important technical problem. This problem is difficult because the matrix is viscous and many of the particles are in the micron and submicron size range. Separation methods and devices tried with some success in separating the particles have been: hydroclones, centrifugation, magnetic separations, solvent extraction, solvent fractionation, and filtration. These techniques suffer, however, in varying degrees from unsatisfactory operation, maintenance, throughput, and cost. To help correct these shortcomings, we have undertaken a study of techniques by which the fine particulates might be enlarged or better collected. Some progress toward that end has been described in the open and patent literature for solvent addition. The laboratory sedimentation test used is described and the effects on settling of solvent dilution, with heating and with the addition of chemical promoters, are presented.

25254 (FE—1212-T-10) **Char oil energy development. Volume II. Appendix B. Final report, August 18, 1971—June 30, 1975.** Jones, J.F.; Brunsvold, N.J.; Terzian, H.D.; Scotti, L.J.; Schoemann, F.H.; Merrill, R.C.; Alcantara, J.D.; Domina, D.J.; Romelczyk, S.J.; Ford, L. (FMC Corp., Princeton, N.J. (USA). Chemical Research and Development Center). Sep 1975. Contract E(49-18)-1212. 295p. Dep. NTIS $9.25.

Computer programs written for Project COED that apply to reported results, pilot plant operations and those of general interest in engineering and project economics work are presented. The purpose of the documentation is to present the programs in sufficient detail that one familiar with the techniques of computer programming can utilize these programs. It is assumed that one intending to use the pilot plant operational programs is conversant with the process and its instrumentation (which has been detailed in previous reports). The purpose of each program and general user information is provided for each program. Most of the programs automatically list the input data and a listing of the input data is given for those that do not. For programs where complicated inputs are required, a data input form is provided to explain the source and organization of the input data. Listings of the computer programs and applicable subroutines are given. As an additional programming and user aid, a listing and brief description of the major variables used in the programs are given.

25255 (FE—1772-13(Vol.3)) **Conceptual commercial design and commercial feasibility evaluation for clean boiler fuel facility. Volume III. Commercial feasibility. Final report.** (Dravo Corp., Pittsburgh, Pa. (USA). Chemical Plants Div.). Feb 1976. Contract E(49-18)-1772. 52p. Dep. NTIS $4.50.

The estimated total plant investment for the 50,000 T/D base case plant design is $1.2 billion. The estimated total capital required, including interest during construction, start-up, costs, and working capital is $1.6 billion. The capital estimate is based on current pricing (late 1975) for process equipment and applying appropriate factors derived from Dravo experience with similar type facilities to obtain the completed plant costs. Based on a typical eastern run-of-mine bituminous coal (Pittsburgh No. 8), priced at $20/ton and using the utility financing method, the calculated average product fuel price is $2.70/MM Btu. This is equivalent to a fuel oil price of $14.77/bbl or $0.35/gal. This is only slightly higher (9 percent, certainly within the estimate accuracy) than current pricing for low sulfur No. 6 fuel oil ($13.50/bbl, East Coast). While the price of imported oil is not precisely predictable, and may cycle over short periods, the general trend is for a steady increase. The factors employed in the utility financing method are based on a variation of the familiar AGA/OCR formula, with a debt/equity ratio of 75/25, a 9 percent interest rate on debt, and a 15 percent net return on equity. The calculations assume a 20-year project life, a straight line depreciation of 5 percent/year of the depreciable assets, and a federal income tax rate of 48 percent. Plant availability is based on 330 days/year. The coal requirement is 16.5 MM t/yr with an as-received gross heat value of 11,760 Btu/lb. Primary products include: heavy fuel oil, SNG, and the LPG faction. By-products include: high-sulfur light oil, elemental sulfur, phenols, pyridine, and ammonia. The by-products are valued at current published prices, adjusted for any appreciable effects resulting from quality differences or volume availability. A calculated thermal efficiency of 62.43 percent includes the heat value of the primary as well as the by-products.

25256 (FE—2307-2) **Research and development of rapid hydrogenation for coal conversion to synthetic motor fuels (Riser Cracking of Coal).** Duncan, D.A.; Beeson, J.L.; Oberle, R.D. (Institute of Gas Technology, Chicago, Ill. (USA)). May 1976. Contract E(49-18)-2307. 39p. Dep. NTIS $4.00.

A bench-scale experimental reactor has been designed to define the important design parameters in the short residence-time hydrocracking of coal to synthetic motor fuels. The reactor is a 50 foot helical coil of $^1/_8$-in. Incoloy tubing that will be heated electrically. Coal feed rates will be 5 to 10 lb/hr with residence times of 1 to 10 seconds. The reactor will operate up to 2000 psig at temperatures of 900 to 1500°F. An experimental plan has been outlined for Bench-Scale Unit Operations. Work in the first 15 months will concentrate on important parameters that would affect the design of a PDU. In due course, carrier streams other than hydrogen will be explored, such as syngas and steam. A detailed operating procedure for the bench-scale unit is included.

25257 **Synthetic-fuel price supports seem inadequate.** Seamans, R.C. *Oil Gas J.*; **73**: No. 4, 78(27 Jan 1975).

Head of ERDA argues that Federal price reports for synthetic fuels will not be satisfactory incentives to reach the President's goal of one million bpd of synthetic fuel capacity by 1985. The possible methods of implementing Federal support are discussed, including a joint federal-industry corporation; the structure of such a corporation is described. The objectives, organization and funding of ERDA are also noted.

25258 **Liquefaction of coal.** Silvestri, A.J.; Naro, P.A. (to Mobil Oil Corp.). US Patent 3,923,634. 2 Dec 1975. Filed date 22 Mar 1974. 10p.

This specification discloses the liquefaction of coal. The liquefaction procedure involves reacting the coal with hydrogen or with a mixture of carbon monoxide and water in the presence of, as a catalyst, a material derived from the naturally occurring underwater deposit known as a manganese nodule. The manganese nodule may be employed without pretreatment or may be pretreated by sulfiding. The catalyst, after it has become deactivated by use, may be processed to remove and recover one or more valuable metallic constituents.

25259 **Hydrogenation of coal.** Schroeder, W.C. US Patent 3,926,775. 16 Dec 1975. Filed date 1 Nov 1973. 12p.

Coal or other solid carbonaceous material is fed under a hydrogenation pressure of about 1,000 to 5,000 psi, in the absence of a pasting oil, to a closed, cyclic, high pressure system including a hydrogenation reactor and a reformer, and is contacted, preferably in the presence of a hydrogenation catalyst, with a stream of superheated steam, hydrogen and carbon monoxide-containing gases which have been produced by passing steam, oxygen and hydrocarbon-containing recycle gases, optionally with added solid carbonaceous material, through the reformer. The hot gaseous stream heats the coal to hydrogenation temperature and the coal is hydrogenated by hydrogen which to a large extent is produced in situ in contact with the coal through steam-carbon monoxide and steam-carbon reactions. The coal is effectively and economically hydrogenated to produce liquid hydrocarbon products and gases for recycling. Tars recovered from the product stream may be hydrogenated in like manner at system pressure with the products of tar hydrogenation being combined with the main product steam.

25260 **Liquefaction study of several coals and a concept for underground liquefaction.** Skidmore, D.R.; Konya, C.J. (West Virginia Univ., Morgantown). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **18**: No. 2, 86-96(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

Automated deep mines now operating in northern Europe require men underground primarily for equipment maintenance. In-situ liquefaction and gasification could eliminate this requirement if some formidable research problems could be overcome. Among these are the development of well completion techniques in coal seams, fracturing, and coal liquefaction technology. Coal has been removed in the laboratory from a coal matrix by suitable solvents. Three fractions of commercially available anthracene oil and one motor oil sample were tested with lignite, subbituminous, and semi-anthracite coals at temperatures up to 450°C and pressure to 900 psi. No gas was introduced and the pressure was generated by the vapor of the solvent. Anthracene oil was more effective than motor oil, but recycled anthracene oil lost reactivity. The subbituminous coal swelled and lost particles whereas the lignite fractured without much swelling. Semi-anthracite showed little reactivity. The mechanism of removal seems to combine physical and chemical effects. In an underground coal liquefaction process, an immiscible solvent would be injected with water as the carrier and flooding fluid. A dipping seam would permit the solvent to float into the reaction area. Host rock should be impermeable and nonreactive. Surface facilities would include those needed for the

drilling and operation of petroleum-type wells and production would be withdrawn in slurry form from the wells for further processing at the surface.

PYROLYSIS AND CRACKING

REFER ALSO TO CITATION(S) 25231

25261 (UCRL—52000-76-4, pp 1-7) **Modeling the pyrolysis phase of in situ coal gasification.** Apr 1976.

In Energy and technology review.

Most experimental and theoretical work on coal gasification has concentrated on the reactions between coal, oxygen, and steam that convert solid coal into gaseous fuel. However, the pyrolysis or thermodecomposition process that precedes these reactions is also important, converting some 40 to 50 percent of the coal resource into low-molecular-weight gases, light hydrocarbons, and tars simply by the action of heat. These pyrolysis reactions are far more complicated and less well understood than gasification reactions because they involve the rearrangement of complicated organic chains and ring structures and the liberation of smaller molecular fragments. To make our modeling of the entire gasification process as realistic and accurate as possible, we investigated these pyrolysis reactions.

25262 (UCRL—78144) **Kinetic studies of gas evolution during pyrolysis of subbituminous coal.** Campbell, J.H.; Stephens, D.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 May 1976. Contract W-7405-Eng-48. 13p. (CONF-760826—1). Dep. NTIS $3.50.

From American Chemical Society meeting; San Francisco, California, United States of America (USA) (29 Aug 1976).

Gas evolution during pyrolysis on Roland seam (Wyodak mine) subbituminous coal was investigated from 383 to 1273°K (110 to 1000°C) in an inert gas (Ar) environment. The effective kinetic parameters (activation energy and frequency factor) for each major gas evolved were determined using nonisothermal kinetic methods. Effective kinetics provide valuable input for modeling processes involving coal pyrolysis (e.g., in situ coal gasification). These kinetic results are summarized in a table. From the experimental results, a quantitative measure of each major gas evolved was also obtained. The temperature region and temperature maximum for the pyrolytic release of each gas were determined. The observed gas evolution processes generally correlated with decomposition of known chemical structures in coal. This provided a good physical picture of the possible chemical reactions during pyrolysis.

25263 **Devolatilization of coal by rapid heating.** Mentser, M.; O'Donnell, H.J.; Ergun, S.; Friedel, R.A. (Bureau of Mines, Pittsburgh). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **18**: No. 1, 26-35(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

Coals were devolatized at rates comparable to those encountered in combustion and gasification processes. Rapid pyrolysis was attained with pulse heating equipment developed for this purpose. This technique permitted the heating time and the final temperature of the coal samples to be controlled. A rate of heating of approximately 10^4 °C/sec was achieved. Coals encompassing a rank from subbituminous A to low volatile bituminous were studied. All bituminous coals exhibited devolatilization curves which were characteristically similar. Decomposition started at about 400°C and increased to a maximum in the region 700-900°C. Beyond the well-defined peak, an increase in volatiles reappeared only at or above 1100°C. Devolatilization of subbituminous A coal differed markedly from this pattern. The products of devolatilization are gases, condensable material or tar, and residual char. Mass spectrometric analysis showed the gas to consist principally of H_2, CH_4, and CO. Higher hydrocarbons, up to C_6, were present in small quantities. The molecular weight of the gas was found to decrease with increase in both reaction temperature and rank of coal. The volume of gases generated from devolatilization increased progressively with increase in temperature, but displayed little variation with rank of coal. Distribution of volatile products between tar and gas was determined for some experimental conditions, and correlations were made between yields of these individual products and the parameters of temperature and rank of coal. Greater volatile yields were obtained from the lower rank coals and clearly were due to increased formation of tar relative to gas. The effect of raising the devolatilization temperature of the coal was to increase the amount of gas at the expense of the tar.

25264 **Deuterium and carbon-13 tagging studies of the plasma pyrolysis of coal.** Krukonis, V.J. (AVCO Corp., Lowell, MA); Gannon, R.E.; Modell, M. *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **18**: No. 1, 56-70(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

When coal is pyrolyzed in a high temperature plasma, acetylene is the principal hydrocarbon product formed; it was found, furthermore, that yields of acetylene in a hydrogen plasma are greater than in an argon plasma. In order to separate the process of hydrocarbon formation during coal pyrolysis from the subsequent quenching step, acetylene decomposition studies were carried out. Acetylene was injected into plasma streams of argon, helium, nitrogen, and hydrogen. In a hydrogen plasma virtually all the acetylene is preserved whereas in the other plasma streams more than half the acetylene is decomposed to carbon. In order to determine the role of hydrogen in preserving acetylene at high temperature, deuterium, as a chemically similar plasma, was used; it was found that "acetylene" in its C_2H_2, C_2HD, and C_2D_2 forms, was present in the same total concentration as when hydrogen was used as the plasma gas. In addition, tests with mixtures of $C_2{}^{12}H_2$ and $C_2{}^{13}H_2$ injected into a hydrogen plasma were made, and again identical "acetylene" concentrations were measured. The deuterium and C^{13} experiments indicate that both C-H and C-C exchange occurs at high temperature and that hydrogen acts as a chemical preserver of acetylene during collision of acetylenic fragments on molecules during the quenching step. A statistical collisional process that occurs during the quenching of the acetylene or coal pyrolysis mixture explains the experimental results.

25265 **Microwave pyrolysis of coal and related hydrocarbons.** Bodily, D.M.; Che, S.C.; Wiser, W.H. (Univ. of Utah, Salt Lake City). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **18**: No. 2, 221-226(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

A microwave field or a microwave-induced argon plasma rapidly heats coal to a high temperature and produces a variety of hydrocarbon products. Acetylene, methane, and hydrogen are the major gaseous products determined by gas chromatographic analysis. Gases produced in coal pyrolysis are subjected to further reaction in a microwave field and the microwave pyrolysis are subjected to further reaction in a microwave field and the microwave pyrolysis of naphthalene is also studied. The kinetics of these pyrolysis reactions are discussed in terms of the mechanism of coal pyrolysis under conditions of very rapid heating and short reaction times.

SOLVENT EXTRACTION

REFER ALSO TO CITATION(S) 25204, 25205, 25248

25266 **Solvent refined coal process for "clean" utility fuel.** Shaver, R.G. (General Tech. Corp., Reston, VA). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **17**: No. 2, 27-35(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P2.

The continued wide use of coal in the United States as a fossil-fuel source of combustion energy for power generation is inescapable in the upcoming decade and beyond. Several processes exist at various stages of development for producing clean fuels from raw coal. Solvent refining is a relatively simple and direct way of deashing and desulfurizing coal that results in fuel products useable as solid or liquid, making it applicable to either coal-fired or oil-fired steam-electric utilities. The projected economics of production and distribution for such use are presented taking no credits for sale of the sulfur by-product and considering production solely for the use of the utilities. As a clean fuel, solvent-refined coal is found to be potentially competitive with desulfurized residual oil, and in many instances, a potentially more economical way to use coal than by gasification. The projected market in the continental United States for solvent refined coal over the range of expected fuel price in the future under clean fuel restrictions is estimated.

25267 **Gas extraction of coal.** Williams, D.F.; Whitehead, J.C. (to Coal Industry (Patents) Ltd.). US Patent 3,970,541. 20 Jul 1976. Priority date 17 Dec 1973, United Kingdom of Great Britain and Northern Ireland (UK). 10p.

Process for the gas extraction of soluble constituents of coal comprises heating the coal in the presence of an extractor to a terminal temperature of 400 to 550°C where the extractant at the terminal temperature is in the gas phase to extract the soluble constituents from the coal and separating the extractant from the

residue and recovering the extract from the extractant. The heating of the coal in the presence of an extractant is at an initial rate of 20°C per minute and preferably as fast as possible to an initial temperature of 370 to 390°C preferably 380°C and thereafter heating the coal to a terminal temperature at a rate not more than 20°C per minute and preferably below 5°C per minute thereby minimizing secondary repolymerization reactions.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 25209, 25255, 25276

25268 Thermal synthesis and hydrogasification of aromatic compounds. Woebcke, H.N.; Chambers, L.E.; Virk, P.S. *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 2, 97-130(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

In synthesizing low-molecular-weight low sulfur fuels from coal, the Stone and Webster Coal Solution Gasification Process utilizes the hydrogasification of liquids derived from coal. As part of our background studies, the homogeneous gas phase hydrogenation of polynuclear aromatic compounds was investigated. In this paper, the probable chemical pathways in converting these aromatics to gas are presented. Analysis and correlation of kinetic data for benzene and anthracene are also discussed, since these two aromatics appear to represent limiting cases. In addition pyrolysis reactions leading to the formation of aromatic compounds, and some ideas on the effect of hydrogen in controlling the distribution of the final products between coke and gas, are outlined.

PROPERTIES

REFER ALSO TO CITATION(S) 25202, 25268, 25957, 26517

25269 (PB—242122) **Precision tests of neutron sulfur meter in coal preparation plant. Research report.** Hall, A.W.; Martin, J.W.; Stewart, R.F.; Poston, A.M. (Bureau of Mines, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Apr 1975. 18p. (BM-RI—8038). NTIS $3.25.

A meter based on measurement of prompt gamma rays from thermal neutron capture in coal was developed for monitoring the sulfur content of coal streams. Neutrons from an 80-microgram californium-252 source penetrate the coal, producing thermal neutrons that are captured by atoms of elements present in the coal. The excited atoms emit prompt gamma rays with energies characteristic of the capturing element. These gamma rays are detected with a 6- by 7-inch sodium iodide detector and processed by electronic equipment to produce a gamma ray energy spectrum of the elements. Tests of the meter at a commercial coal preparation plant showed that sulfur in moving coal can be determined to a precision of 0.05 percent sulfur within 2 minutes. Reliability of the coal handling system proved inadequate for long term operation and improvements are planned. (GRA)

25270 Alkylation and depolymerization reactions of coal: a selective review with supplementary experiments. Larsen, J.W.; Kuemmerle, E.W. (Univ. of Tennessee, Knoxville). *Fuel;* **55**: No. 3, 162-169(Jul 1976).

Not only can coals be alkylated readily, they also can be used to alkylate aromatic compounds. With both types of reaction, soluble products are formed that can be analyzed using techniques which are not suitable for unreacted coal because they require soluble material. It is this factor which causes much of the interest in alkylation reactions of coal. Much structural information can be obtained using soluble, reacted, coals which is impossible to obtain using the non-soluble unreacted coal. Also, the two techniques give different and complementary products which in combination provide important information about coal structure that is difficult to obtain by other means. There is now enough information available for its consideration to yield insights into coal structure and reactivity and to suggest many new experiments. That is the purpose of this review.

25271 Estimation of coal aromaticities by proton-decoupled carbon-13 magnetic resonance spectra of whole coals. VanderHart, D.L.; Retcofsky, H.L. (National Bureau of Standards, Washington, DC). *Fuel;* **55**: No. 3, 202-204(Jul 1976).

A recently developed nuclear magnetic resonance (NMR) cross-polarization technique has been applied to obtain high-resolution carbon-13 spectra of vitrains from two coals. The method, which overcomes the problem of dipolar line broadening by protons, permits estimates of the carbon aromaticities of solid coals. Preliminary results support the classical views that coals are highly aromatic materials and that the aromaticity of coal increases with increasing rank. Limitations of the technique, the accuracy of representation of the distribution of carbons in the sample, and consequently the reliability of the resulting f/sub a/ values are discussed.

25272 Solvent effects in the depolymerization of coal. Darlage, L.J.; Bailey, M.E. (Pikeville Coll., KY). *Fuel;* **55**: No. 3, 205-210(Jul 1976).

The depolymerization reaction of coal in the presence of Friedel—Crafts catalysts in a variety of phenolic and non-phenolic solvents has been investigated. Only the phenolic solvents were found to be useful in this reaction. Some interesting substituent effects were discovered when the isomeric cresols and dihydroxybenzenes were employed as solvents. The influence of temperature and catalyst concentration on the degree of depolymerization has also been examined. With non-phenolic solvents, polymerization is the predominant reaction.

25273 Inferences regarding the nature of solvent-refined coal (SRC). Wooton, D.L.; Dorn, H.C.; Taylor, L.T.; Coleman, W.M. (Virginia Polytechnic Inst. and State Univ., Blacksburg). *Fuel;* **55**: No. 3, 224-226(Jul 1976).

Solvent-refined coal product has been subjected to numerous analytical techniques in an effort to ascertain its chemical nature. Electron spin resonance, ^{13}C and ^{1}H nuclear magnetic resonance, and mass spectroscopy along with elemental and molecular weight analyses have been employed. High-performance liquid chromatography via gel permeation separates tetrahydrofuran-soluble SRC into several size fractions. Nuclear magnetic resonance data strongly suggest that hexamethylphosphoramide-soluble SRC is approximately 95 percent aromatic in character.

25274 Transmission electron microscope observations of porosity in coal. Harris, L.A.; Yust, C.S. (Oak Ridge National Lab., TN). *Fuel;* **55**: No. 3, 233-236(Jul 1976).

Samples of a high-volatile bituminous coal (HVab) were examined by means of transmission electron microscopy in a high-voltage electron microscope (1 MeV). The porosity observed within the exinite and inertinite constituents of this coal falls primarily into the mesopore size range (2—50 nm). Small particles (approximately 25 nm in diameter) were seen in a majority of the exinite pores and are believed to have acted as catalysts in the pore formation.

25275 Use of daf and dmmf ultimate analyses of coals. Given, P.H. (Pennsylvania State Univ., University Park). *Fuel;* **55**: No. 3, 256(Jul 1976).

Attention is drawn to problems in the determination and reporting of the elemental composition of coals, particularly with respect to definitions (dry-ash-free and dry-mineral-matter-free), the method of oxygen determination, the necessity of various corrections, and errors. The problems in interpreting analytical data on coal are recapitulated more fully in a referenced report. (LTN)

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 25706, 26497, 26499, 26506, 26513, 26515, 26521

25276 Cellulosics for the removal of sulfur dioxide from flue gas streams. Meyers, R.A.; Land, J.S.; Shih, C.C.; Lewis, J.L. (to TRW Inc.). US Patent 3,629,996. 28 Dec 1971. Filed date 19 Feb 1970. 5p.

Sulfur dioxide contained in flue gases from a coal-burning thermal generating plant can be sorbed on finely divided cellulose such as a shredded paper at temperatures in the range of 215-300°F. After the cellulose has been saturated with the SO_2, it is desorbed by flue gas at about 350-450°F. The desorbed SO_2 may be then conveniently forwarded to a plant for processing to sulfuric acid. Spent cellulose may be forwarded to the plant for burning or it may be further digested to carbohydrates. Previously, cellulose was not utilized commercially for SO_2 sorption, since lengthly desorption times were required and it was not known that SO_2 could be desorbed at all from the cellulose. Therefore, this process proves that within a preferred temperature range, the desorption of SO_2 from the cellulose occurs quickly. This not only permits efficient utilization of the cellulose, but also enables cycling of the cellulose from desorption to sorption and vice versa. A large cellulose inventory is thus not required, and rapid cycling permits conservation of the heat contained in the cellulose.

25277 Apparatus for desulfurization of exhaust gas. Arashi, N.; Hishinuma, Y. (to Hitachi, Ltd., Tokyo). US Patent 3,803,804. 16 Apr 1974. Filed date 18 Nov 1971. 6p.

An adsorption apparatus is described for desulfurization of stack gases containing sulfur oxides which requires less installation space and is manufactured at less cost than similar prior art devices and which controls the exhaust gas temperature and humidity for enhancement of SO/sub x/ adsorption efficiency. The apparatus consists of several desulfurization towers containing an adsorbent layer and means for selectively introducing the exhaust gases into the lower bottom for passage upwardly through the adsorbent layer. A distributor is situated in the upper portion of the lower chamber formed in the tower immediately below the adsorbent and causes liquid-gas contact between the description solution containing sulfuric acid and the exhaust gas in the tower s lower chamber.

25278 Waste coal reclamation. Leonard, J.W.; Lawrence, W.F. *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **18**: No. 2, 232-238(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

It appears possible that many existing coal refuse piles (culm banks) can be possibly reclaimed and burned using new, modified, or existing combustion processes to produce needed energy while converting the unsightly refuse piles to greatly reduced quantities of more readily useable materials. Important factors to be considered before such applications include sampling and testing of culm banks to determine their chemical composition and physical properties, determining the history of formation of the bank, clarifying the ownership of the bank and surrounding land, and examining the potential ecologic effects of mining the bank site. Factors which control the contents and fuel values of individual culm banks and the possible effects of using such reclaimed fuels and power stations are presented.

25279 Demand for sulfur control methods in electric power generation. Jimeson, R.M. (Federal Power Commission, Washington, DC). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **17**: No. 1, 88-101(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P1.

Federal and state sulfur oxide control regulations are translated into demands for various quality fuels and control devices to meet requirements for electric power generation. The current status and forecast for the power industry are presented.

25280 Chemistry of the molten carbonate process for SO_2 removal from stack gases. Yosim, S.J.; Grantham, L.F.; McKenzie, D.E.; Stegmann, G.C. *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **17**: No. 2, 98-104(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P2.

The Molten Carbonate Process consists of three steps: the scrubbing of SO_2 by a ternary eutectic alkali metal carbonate melt; the reduction of the sulfite and sulfate reaction products with petroleum coke; and the reaction of the resulting sulfide with steam and CO_2 to regenerate the carbonate and to form H_2S, which in turn can be converted to elemental sulfur. The detailed chemistry of each of these steps will be discussed. The chemistry of the scrubbing step is complicated by side reactions of both oxidation and disproportionation of sulfite. The reactions in the reducer are straightforward involving carbon reacting directly with the sulfite and sulfate. The chemistry of the regeneration step includes a side reaction of CO_2 with the sulfide. The chemistry of several other aspects of this process are discussed including the process for recovering Li_2CO_3 from the fly ash-salt cake and the selection of corrosion-resistant materials of construction. Finally, a brief description of the pilot plant to be built at the Arthur Kill Power Station of Consolidated Edison Company is given.

25281 Method of reducing sulfur dioxide emissions from combustible materials. Withorn, B. US Patent 3,948,617. 6 Apr 1976. Filed date 19 Feb 1974. 4p.

The reduction of emission of sulphur dioxide from fuels containing sulfur components when such fuels are combusted is described. The reduction of such sulfur dioxide emissions upon the combustion of such sulfur containing fuels is accomplished by the introduction into such fuels of an alkali additive which is pressure fed into such fuels at a point closely adjacent to the burner structure for the combustion process, thus insuring for the intimate mixture of such alkali material with the fuels to be combusted. The alkali material serves to neutralize the sulfur-containing impurities which are normally caused to exit through a conventional stack exit for the exhaust gases from the burner.

25282 Method for desulfurizing exhaust gas by alkali sulphite—gypsum process. Morita, T.; Funahashi, I.; Sugai, M.; Sasakawa, A.; Takaiwa, M. (to Kureha Kagaku Kogyo Kabushiki Kaisha). US Patent 3,965,242. 22 Jun 1976. Priority date 23 Feb 1972, Japan. 6p.

A process is described for thorough desulfurization of exhaust gas by treating the gas through the steps of absorption, double decomposition, oxidation, and alkali sulfate conversion.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 25224, 25287, 25288, 25289, 25703, 25840, 25956, 26184, 26479, 26485, 26558, 26561, 26668

25283 Low sulphur coal supplies for environmental purposes. Hunter, T.W. (Bureau of Mines, Washington, DC). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **17**: No. 1, 67-70(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P1.

Environmental considerations are sharply narrowing the nation's coal resource base and emphasizing the need for more information on low sulfur coal reserves, particularly in the eastern United States. Pending economic processes for the reduction of pollutants, coal supplies for environmental purposes will be increasingly tight. Low sulfur coal reserves are estimated at 96 billion tons in Appalachia and 916 billion tons in the west, or 48 and 458 billion tons, respectively, at 50 percent recoverability. There are many practical problems in making these coals available to the energy market, however. Regardless of demand, except under long-term contracts additional deep mine capacity is being deterred by current claims for accelerated nuclear power generation, oil imports, environmental pressures, and the potentials for stack gas emission processes that will permit the use of higher sulfur coals. Although western coals have significant potentials in midwestern markets, their lower Btu values will require more tons than of eastern coal. Nor are all low sulphur coals readily usable in all types of combustion equipment. Given the present outlook for other indigenous energy sources, coal must be a major component of our energy structure for many years ahead. Accordingly, to effectively attain both our economic and social objectives compatibility must be achieved between the demands of society and the inherent characteristics of our coal resources, including the appraisal of environmental regulations to make sure that they are no more stringent than is necessary.

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 25283, 25288, 25955

25284 Index map and bibliography of coal studies in Montana. Butte, MT; Montana Bureau of Mines and Geology (1976). vp. $0.55.

Coal deposits in various parts of Montana have been described in more than eighty reports since the first such publications were issued in 1907. To ease the task of determining what has been written about a specific area, the Montana Bureau of Mines and Geology has printed an Index Map and Bibliography of Coal Studies in Montana, compiled by John M. Pinchock. On a base map that shows county lines, township lines, drainage systems, and towns, the area described in each report is outlined and is keyed by a number to the specific report. All reports are listed on the margin of the sheet. They are arranged in chronological order, and each entry consists of (1) the number by which it is keyed to the map outline, (2) the date, (3) the name of the author or authors, (4) the title of the report, (5) the publishing agency or journal, and (6) the page numbers. The user can readily determine whether the coal deposits in a specific area have been described and if so, when and by whom.

MINING

REFER ALSO TO CITATION(S) 25294, 25295, 25302, 26350

25285 (FE—1231-3) **Design optimization in underground coal systems. Interim report, October—December 1975. Section 1. Structural parameters of coal measure rocks. Section 2. Longwall mining system strata simulator. Section 3. Design criteria for underground roof-truss support systems.** Lucas, J.R. (ed.). (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Div. of Minerals Engineering). Mar 1976. Contract E(49-18)-1231. 155p. Dep. NTIS $6.75.

The major thrust of this quarter's efforts was the development of the data cross-reference computer program which is now 75 percent complete and operational. The purpose of this program is to reduce experimental results obtained from coal testing and store this data on a disk along with all other pertinent data associated with the coal sample. To date program plots of load vs. edge length, and averages of modulus of elasticity, ultimate stress, and edge length have been made. Work has continued on refinement of the two-dimensional, body-loaded, photoelastic longwall model. Stress-strain characteristics for the model chock, developed the previous quarter, were determined experimentally for the expected loading range. Additional roof support tests have been performed analyzing the effects of blocking points, the depth of anchor placement, the thicknesses and sequencing of roof strata, and the opening height. The height of the opening has no effect on the model roof truss characteristics. Multiple blocking points were slightly more efficient than collar blocking points in the model. The depth of placement of the truss anchor had little influence on the performance of the model roof truss. The thickness and sequence of roof strata can have an important effect on roof support. Weak immediate thick layers overlain by weak thin layers as well as thin immediate roof layers overlain by thicker layers can be supported well by the roof truss.

25286 (PB—241176) **Feasibility study on the use of foam to reduce respirable dust on a Joy CM continuous miner. Contract research report, Jun 1973—Jun 1974.** Achenbach, T. (Peabody Coal Co., St. Louis, Mo. (USA). Chemcoke Div.). 10 Jun 1974. Contract H0133110. 32p. NTIS $3.75.

Operating in the Illinois No. 6 coal seam, the effectiveness of foam opposed to water was compared in reducing respirable coal dust. A combination of 39 foam generators and 14 water sprays were used during the foam tests. Sixty-one water sprays were operated during the water tests. Results of 45 shifts of dust sampling (24 with foam and 21 with water) show no significant difference in dust levels at the miner operator, shuttle car operator, and belt transfer point when either foam or water was used. Results of this foam contract concur with results of previous foam contracts; that is, the use of a water spray system is currently the most feasible and economical means of abating respirable dust at the face. (GRA)

25287 (PB—241510) **Hydraulic model studies for backfilling mine cavities. (Second series of tests).** Carlson, E.J. (Bureau of Reclamation, Denver, Colo. (USA). Engineering and Research Center). Mar 1975. Contract H0230011. 46p. (REC-ERC—75-3). NTIS $3.75.

See also PB—225613.

Hydraulic model tests to study different aspects of backfilling mine cavities with sand and waste material to reduce subsidence of land at the surface above the mine cavities are discussed. Tests were made in the model of an idealized coal mine that was operated to determine the results of various conditions where mine cavities are backfilled by pumping a fine sand slurry. Fine, uniform blow sand having a median size of 0.14 mm obtained from the Rock Springs, Wyoming area was used to produce the sand slurry. (GRA)

25288 Map of coal-mining features, Allegheny County, Pennsylvania. Davies, W.E.; Pomeroy, J.S.; Kohl, W.R. Reston, VA; U. S. Geological Survey (1976). vp. $1.00 per set.

This map is one result of a series of studies sponsored by the Appalachian Regional Commission as part of a larger U. S. Geological Survey program of environmental analysis of a part of southwestern Pennsylvania. The map summarizes surface features resulting from coal mining. The distribution of surface features is largely from 1973, 1:12,000 scale aerial photographs verified by field reconnaissance in 1973 and 1974. Supplementary interpretations relative to surface subsidence were done using 1939 aerial photographs. Various coal beds are described under the heading Coal Geology and Mining. The environmental effects of coal mining are discussed from the standpoint of underground mining, strip mining, and slag dumps.

25289 Monitoring ground-water contamination with geophysical methods. Greenfield, R.J.; Stoyer, C.H. (Pennsylvania State Univ., University Park). *Trans. Soc. Min. Eng. AIME;* **260**: No. 1, 20-23(Mar 1976).

From SME Fall meeting; Pittsburgh, PA, USA (Sep 1973).

A geophysical survey was made in Kylertown, Pa., in an area where the ground water is polluted with acid mine drainage. Since acid mine water is a good electrical conductor, both direct-current electrical and electromagnetic loop methods were examined for their ability to determine the subsurface electrical conductivity structure and from this to imply the location of the acid water. Consistent results were obtained with the two methods and the interpreted subsurface resistivities were consistent with the electrical resistivity measured for water samples. It was demonstrated that fracture traces which act as conduits for ground water flow can be located with electromagnetic surveying methods. Thus geophysical methods for measuring subsurface electrical resistivity can be used to advantage for monitoring the environmental impact on the ground-water system of acid mine water.

25290 Shear resistance of rock bolts. Haas, C.J. (Univ. of Missouri, Rolla). *Trans. Soc. Min. Eng. AIME;* **260**: No. 1, 32-41(Mar 1976).

From AIME annual meeting; New York, NY (Feb 1975).

The effectiveness of rock bolts in resisting shear displacement along preexisting fracture surfaces or slip planes was determined in the laboratory with full-scale bolts and large-scale shear test equipment. The system variables were the type of bolt, orientation of bolt relative to shear surface, and normal pressure on the interface. Results showed that, in general, both conventional bolts and resin-grouted reinforcing bars significantly increase the shear resistance along a fracture or bedding plane when the average normal compressive stress on the plane is in the order of 25 psi and when the bolt is oriented such that it tends to lengthen as the shear progresses. An increase in shear resistance is also noted at the higher normal pressure of 250 psi; however, the increase is small compared to the corresponding shear resistance without a bolt. Conventional bolts oriented such that they lose tension as shear displacement occurs added no shear resistance since the tension drops to zero at very small shear displacements.

25291 Inexpensive method helps predict methane content of coal beds. McCulloch, C.M.; Diamond, W.P. (Bureau of Mines, Pittsburgh). *Coal Age;* **81**: No. 6, 102-106(Jun 1976).

Some coal mines are so gassy that it is difficult to keep methane concentration down, even though a considerable amount of air is forced down the section. The US Bureau of Mines has developed a number of techniques that would permit a mine operator to drain the methane from a coal bed either during mining or ahead of it. Such degasification increases safety, reduces ventilation expenditures, increases productivity, and may even have the added benefit of providing a salable pipeline-quality gas. Now, researchers at the Bureau's Pittsburgh center have come up with an inexpensive method of calculating the gas content of a coal bed from exploration cores before mining. The resulting data and design charts can be used to estimate the gas resource potential of the coal bed and to design adequate mine ventilation systems to handle any problem. Cost of the analytical equipment is less than $100, and the time required to conduct the tests is normally less than one month.

TRANSPORT AND HANDLING

25292 (FE—1792-12) **Coal feeder development program. Quarterly technical progress report, January—March 1976.** (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). 31 Mar 1976. Contract E(49-18)-1792. 50p. Dep. NTIS $4.00.

During the study phase (Phase I) four concepts of the Coal Feeder were identified for further consideration and recommended for experimental evaluation under Phase II. These systems are: (1) the Ejector, using ejector pumps; (2) the Kinetic Extruder, using centrifugal forces to compact and extrude the pulverized coal; (3) the Ball Conveyor using gravity forces to feed the coal, and (4) the Fluid Dynamic task using bladeless disk type compressors. During the quarter covered by this report effort was concentrated on the refinement of the analytical tools and the design of test equipment and the test loop.

25293 Method and apparatus for conveying and/or heating coal particles in a dense phase flow. Albright, C.W. (to Union Carbide Corp.). US Patent 3,963,415. 15 Jun 1976. Filed date 10 Jan 1975. 18p.

An improvement is described in a method and apparatus for conveying and/or heating coal particles in a dense phase flow through transfer lines wherein the velocity of the flow through the lines is controlled by a progressive enlargement of line size during indirect heating and/or transfer in the lines thereby minimizing erosion of the transfer lines by the coal particles.

25294 Sump and pump construction for conveying solids in the form of a slurry. Haentjens, W.D. US Patent 3,966,262. 29 Jun 1976. Filed date 24 Mar 1975. 8p.

Apparatus for removing solids such as coal from the discharge end of a continuous mining machine in the form of a slurry is described. The apparatus includes an inner sump for water and mined coal to form a slurry. A high capacity pump is in the bottom of the inner sump and has a capacity sufficient to maintain a uniform level of water in the sump and to pump the heavier solids settling to the bottom of the sump. The mined coal is supplied to the inner sump to be formed into a slurry by the water kept in a state of high agitation by the entrance angle of the water and the coal discharged therein. An outer sump extends about and fully contains the inner sump and has side walls substantially higher than those of the inner sump to collect the overflow from the inner sump in the form of dirty water and fines. A low capacity pump takes the overflow of dirty water and fines.

25295 Coal slurry recovery systems. Doerr, R.E.; McCain, D.L.; Davis, D.H. (to Continental Oil Co.). US Patent 3,966,261. 29 Jun 1976. Filed date 30 Jun 1975. 6p.

Improvement structure for use in mine slurry conveyor systems of the type which transport mined material from a plurality of work spaces in the mine to a remotely disposed recovery and finishing plane is described. The system utilizes permanent tank or silo storage of slurry and water at a centralized point within a mine for reception of material slurry from all work faces in order to re-regulate slurry concentration for further conveyance out of the mine to a recovery station. The slurry silo communicates with a positive solids feed device which deposits mined material into a submerged slurry pit for re-slurry mixing at controlled rate of positive solids feed and agitation of re-slurry water whereupon the adjusted slurry is hydraulically conveyed to the recovery station.

COMBUSTION

25296 (ANL/ES-CEN—1014) **Development program on pressurized fluidized-bed combustion. Quarterly report, October—December 1975.** Vogel, G.J.; Cunningham, P.T.; Fischer, J. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 92p. Dep. NTIS $5.00.

A development program on pressurized fluidized-bed combustion is being carried out in a bench-scale pilot plant capable of operating at 10-atm pressure. The concept involves burning fuels such as coal in a fluidized bed of particulate lime additive that reacts with the sulfur compounds formed during combustion to reduce air pollution. Nitrogen oxide emissions are also reduced at the combustion temperatures used, which are lower than those used in a conventional coal combustor. The $CaSO_4$ produced in the combustor is regenerated to CaO that is recycled to the combustor for removal of sulfur compounds. Information is presented on: hot testing of the new bench-scale regeneration system, TGA experiments on sulfation and regeneration rates of supported additives and on cyclic sulfation regeneration experiments, petrographic change occurring during half-calcination of dolomite, laboratory-scale experiments on the reaction of calcium sulfide with calcium sulfate, coal combustion reactions, and quality of fluidization and minimum fluidization velocity studies.

25297 (FE—2201-5) **Develop a concept for fluidized-bed combustion of consol char using closed-cycle gas turbine. Interim report for period ending May 21, 1976.** Himmelblau, A. (Energy Resources Co., Inc., Cambridge, Mass. (USA)). May 1976. Contract E(49-18)-2201. 10p. Dep. NTIS $3.50.

Design and computer programming effort in developing a combined cycle power system using potassium vapor in a closed cycle gas turbine system and steam in a 3 stage turbine system with reheating between stages is reported. The computer programming effort is for the purpose of optimizing the conceptual design, which is described briefly with the aid of a flow sheet.

25298 (ORNL/MIT—222) **Determination and correlation of solids recirculation rate in a recirculating gas fluidized bed.** Piret, J.J.; Bush, J.R.; Costa, J.M.; MacWilliam, G.L. (Massachusetts Inst. of Tech., Oak Ridge, Tenn. (USA). School of Chemical Engineering Practice). 17 Dec 1975. 33p. Dep. NTIS $4.00.

A mathematical model of a recirculating fluidized bed was developed to predict the gas flows necessary for desired recirculation of solid. Experiments performed on a cylindrical laboratory-scale bed confirmed the validity of the model. An empirical correlation between recirculation rate and operating parameters was also obtained.

25299 (SAND—76-8227) **Nitrogen oxide formation from chemically-bound nitrogen during the combustion of fossil fuels.** Mitchell, R.E. (Sandia Labs., Livermore, Calif. (USA)). Jun 1976. Contract AT(29-1)-789. 25p. Dep. NTIS $3.50.

One of the many problems associated with the firing of fossil fuels is the impact on the ambient levels of nitrogen oxides. Since the use of coals, oils and coal-derived fuels is expected to triple by 1985, it is urgent that the formation of nitrogen oxides from molecular nitrogen and organo-nitrogen species be fully characterized so that emission abatement strategies can be formulated. The thermal fixation of atmospheric nitrogen and the free radical reactions of nitrogenous species are the sources of NO/sub x/. The fixation reactions can be described by the extended Zeldovich mechanism, and techniques such as staged combustion and flue gas recirculation have been employed to reduce combustion temperatures and, hence, thermally formed NO. These techniques have had little effect, however, on the conversion of chemically-bound nitrogen to NO/sub x/. The fate of chemically-bound nitrogen depends upon such factors as the nitrogen content of the fuel and the equivalence ratio and upon the physical processes governing combustion. Research is proposed to establish the kinetic processes involved in the conversion of fuel nitrogen to NO and N_2 in environments characteristic of fossil fuel combustion and to identify those conditions which favor the reduction of NO to N_2.

25300 (SAND—76-8229) **Combustion rates and mechanisms of pulverized coals and coal-derived fuels.** Hardesty, D.R. (Sandia Labs., Livermore, Calif. (USA)). Jun 1976. Contract AT(29-1)-789. 37p. Dep. NTIS $4.00.

Increased use of coal, our most abundant fossil fuel resource, will be required to meet both immediate and long-term energy demands. Improvement in existing technologies of steam raising and industrial process heating through the clean, direct firing of pulverized coal will have major and immediate impact. Improvements are required because of the unacceptably high emissions from present coal combustion systems and because of the need to couple considerations of pollutant emissions and carbon conversion efficiencies. The rates and mechanisms of coal devolatilization and combustion are extremely sensitive to local details of the combustion process. Similarly, pollutants formed during the process are sensitive to the initial coal composition and local time and temperature histories of individual particles. Very little useful information is available by which the influence of combustion modifications on both the efficiency and pollutant emission characteristics can be predicted. The present understanding of the rates of coal and char combustion is summarized with the conclusion that heterogeneous chemical kinetic rates strongly influence the rates and mechanisms of coal and char combustion. If understood, adjustment and control of the rates and mechanisms by judicious adjustment of the combustion process and the initial fuel character should be possible. A proposal for a detailed theoretical and experimental study of the combustion rates of pulverized coal and coal-derived fuels is discussed.

25301 Problems in pulverized coal and char combustion. Gray, D.; Cogoli, J.G.; Essenhigh, R.H. (Pennsylvania State Univ., University Park). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **18**: No. 1, 135-164(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

Interest in char combustion derives from the need to utilize the char produced during some gasification processes. Successful use of char in combustion may depend on use with supplementary fuel. The critical factor determining this appears to be the char reactivity which may be variations in intrinsic reactivity depending on differences in thermal history, or it may be dependent on differences in internal surface. In preparation for an experimental program to determine the relative significance of these alternatives (or others), what are considered relevant contributions in the existing experimental literature have been re-evaluated. Although overall surface reaction rates have been evaluated for many coal chars there appears to have been a fundamental omission in the kinetic analysis, and an attempt to remedy this has been made. The picture now developed is that of char particles that may burn either in Zone I or Zone II depending on the particle permeability. Zone III combustion is not encountered with particles below about 100 microns. In Zone I and II combustion, however, the intrinsic reaction is evidently a zero order, high activation energy process (E about 45 kcal) at temperatures in the region of 1000°K, changing to a first order, low activation energy process (E about 7 kcal) at temperatures approaching 2000°K, with both processes significant in the transition range between the two limits. This new evaluation modifies the conventional views of reaction order and activation energies.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 25286, 25291

25302 (PB—241616) **Impact study of mine safety foreman training for a selected site. Final report, 29 Jun 1974—1 Feb 1975.** (Reyes (J.A.) Associates, Inc., Washington, D.C. (USA)). 1 Feb 1975. Contract S0144142. 151p. NTIS $6.25.

The report is an examination of relationship between training in safety of mine foremen and accident frequency rate in exploratory samples of five selected coal mines. Limited data show a significant sequential decline in accident rate after training, but does not conclusively prove the extent of causal relationships, since other factors also contributed to the decline. (GRA)

25303 **Near term results: coal mine safety research.** Yanrik, J.J. *Min. Congr. J.*; **60**: No. 5, 18-24(May 1974).

This progress report highlights some of the significant products from Bureau of Mines coal mine health and safety research that are available for industry use. Research has been conducted in the areas of advancements in mining systems, improved conventional and continuous mining equipment, new conventional mining systems, shortwall mining, single entries, roof and rib control, respirable dust, machinery and electrical hazards, fire control, ventilation and methane gas control, and breathing apparatus.

PETROLEUM

REFER ALSO TO CITATION(S) 25197, 25199, 25942, 25959, 25961, 25987

25304 (UCRL-Trans—11048) **Development of the petroleum and gas industry.** Translated from *Geogr. Shk.*; **22**: No. 1, 77-78(1959). 4p. Dep. NTIS $3.50.

The 1958 Seven Year Plan provides for an increase in crude oil production to 230 to 240 million tons by 1965 (a twofold increase in 7 years). Natural gas production is supposed to increase to 150 billion cm^3 in 1965, compared to 30 billion in 1958 (a fivefold increase). Although coal production will grow, crude oil and gas production will grow faster and from 31 percent of total fuel production in 1958 to 51 percent in 1965. Certain new oil and gas fields, petroleum refinery and gas pipeline construction, and use of natural gas as a chemical feedstock are discussed briefly. The use of petroleum by-product gases for the manufacture of fertilizers, synthetic fibers, plastics and detergents will be increased by many times. (LTN)

EXPLORATION

REFER ALSO TO CITATION(S) 25320, 25364, 25365, 25366, 25368, 25964

DRILLING AND PRODUCTION

25305 (BERC—0003-7) **El Dorado micellar—polymer project technical letter for February, 1976.** (Cities Service Oil Co., Tulsa, Okla. (USA)). Feb 1976. Contract E(34-1)-0003. 38p. Dep. NTIS $4.00.

Preliminary results of a well stimulation program consisting of a solvent-acid treatment appear quite favorable. Considerable effort was made on site and in the laboratory to determine the major factors responsible for the less than desirable water quality being found in the field. (LK)

25306 (BERC—0003-9) **El Dorado micellar—polymer project technical letter for April, 1976.** (Cities Service Oil Co., Tulsa, Okla. (USA)). Apr 1976. Contract E(34-1)-0003. 15p. Dep. NTIS $3.50.

The well stimulation program has continued to appear favorable initially; however, the injection rates have tended to decrease slightly. In an attempt to maintain the high level of injectivity obtained after the acid treatment, four wells were acidized with a larger acid volume. The results are currently being reviewed. A total of 25,578 and 24,207 barrels of pretreatment fluids were injected into the Chesney and Hegberg patterns, respectively. Four oil recovery flow tests were conducted to investigate the effectiveness of the latest Shell design in displacing residual oil from El Dorado cores. These tests were made using 0.1, 0.25, 0.5, and 2.0 pore volumes of chemical slug with Kelzan F polymer and the drive water and preflush specified by Shell. It was found that residual oil saturation can be reduced to approximately 5 percent of the pore volume with preflush and continuous injection of chemical slug through 2-in.-diam stacked cores about 10 in. long. Other chemical work has included a study of the solid residue formed in the Shell micellar concentrate, chemical analyses for the wax content of oil, and preparation of cores for wettability tests. Tests designed to determine any wettability changes due to preheating of cores up to 120°F were run. The wettabilities of the heated cores were somewhat less negative than those of the unheated cores. Performance prediction work has included a comprehensive study of reservoir sweep and oil recovery versus well rates, additional work on polymer simulation, and a review of Hall and Muskat plots.

25307 (BNWL-SA—5658) **Well-hole temperature distribution in the presence of aquifers.** Oster, C.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1976. Contract E(45-1)-1830. 38p. Dep. NTIS $4.00.

A method is described for determining the temperature distribution in a circulating drilling fluid when aquifers are present in the formation. The depth of an aquifer relative to the well depth is shown to be an important parameter. An aquifer near the surface has much less influence on the temperature distributions than one located near the well bottom. If the drilling fluid has much greater density than the entering formation water then the temperature distributions are altered significantly.

25308 (CONF-7506131—1) **Monitoring acoustic emission from propagating fractures in petroleum reservoir rocks.** Shuck, L.Z.; Keech, T.W. (Energy Research and Development Administration, Morgantown, W.Va. (USA). Morgantown Energy Research Center). 1975. 44p. Dep. NTIS $4.00.

From Conference on acoustic emission (microseismic activity) in geologic structures and materials; University Park, Pennsylvania, United States of America (USA) (9 Jun 1975).

The results presented here are from a continuing petroleum reservoir stimulation research program at the Morgantown Energy Research Center (MERC) of the U.S. Government Energy Research and Development Administration (ERDA). The research pertains to hydraulic fracturing of oil and gas reservoir rocks with specific emphasis placed upon the acoustic mapping of induced fracture orientations, lengths and rates of propagation, and the mechanisms governing fracture propagation in oil and gas reservoirs. Information presented here is based upon a field experiment for acoustically mapping hydraulic fractures, and laboratory studies on acoustic emission from fracture initiation and growth in reservoir rocks. The field experiment was conducted in a petroleum reservoir in Bradford, Pa. Twelve hydrophone type sensors were placed at the oil bearing rock elevation of 2,030 feet from the surface in adjacent wells surrounding the fractured well. Complete directional acoustic velocity distribution and acoustic background noise levels were evaluated. The resulting measurements made during the hydraulic fracture mapping experiment, data analysis techniques and problems are discussed. Instrumentation developed and used in the data reduction and analysis is described. Laboratory hydraulic fracture stimulation experiments conducted in reservoir rocks are discussed with a description of techniques, instrumentation, and data analysis included.

25309 (COO—0019-4) **Interfacial effects in the recovery of residual oil by displacement: studies at Northwestern University. Quarterly technical progress report, September 1, 1975—November 30, 1975.** Slattery, J.C.; Kovitz, A.A. (Northwestern Univ., Evanston, Ill. (USA)). Dec 1975. Contract E(34-1)-0019. 7p. Dep. NTIS $3.50.

The programming is completed for the necessary numerical computations to determine for a single irregular pore partially filled with residual oil, the critical value of the pressure drop across the pore, below which the residual oil will not be displaced but will instead assume a static configuration. A Version II of the meniscal breakoff apparatus was designed and constructed for use in the study of the measurement of small interfacial tensions by the rod-in-free surface meniscal breakoff method. (LK)

25310 (MERC/TPR—76/4) **Prediction of fracture orientation from oriented cores and aerial photos in Sand Draw Field, Wyoming.** Komar, G.A.; Overbey, W.K. Jr.; Watts, R.J. (Energy Research and Development Administration, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Jul 1976. 16p. Dep. NTIS $3.50.

A request for a qualified prediction of the compass direction that induced hydraulic fractures follow in the Sand Draw Field in Wyoming led to a joint effort between the Morgantown Energy Research Center and an operating company in the area. An oriented core of the producing sand was obtained and evalua-

tion measurements of directional rock properties and data obtained and the interpretations were used in completing this study. Results indicate the directions of induced hydraulic fracturing might be reliably found within +-10 degrees of the azimuth bearing N 70 W.

25311 (NSF-RA-N—74-251) **Assessment of enhanced recovery technology as a means for increasing total crude oil recovery in Texas. Project N/T-6, final report.** Lohse, E.A. (Gulf Universities Research Consortium, Houston, Tex. (USA)). Dec 1974. 76p. (GURC—141). National Science Foundation, Washington, DC.

For Governor's Energy Advisory Council of Texas.

Enhanced recovery (ER) refers to chemical and/or thermal treatment of oil reservoirs to increase the production of crude oil beyond those amounts recoverable by natural reservoir energy ("primary recovery" by water drive or gas pressure) or by artificial maintenance of reservoir energy ("secondary recovery" by waterflood or gas injection). Current ER methods consist of (1) polymers to thicken reservoir water for more uniform sweep of water through the reservoir, (2) miscible fluids to reduce interfacial tension between the reservoir rock's very small pore spaces and the oil, or (3) heat applied in some form such as steam or underground combustion. It is estimated that between six and 12 percent of the U.S. domestic ROIP could be recovered by presently available ER methods after sufficient field testing to transfer "on-the-shelf" technology to actual field methodology. This would produce 18.5 billion barrels (with 80 percent probability) to 36.3 billion barrels (with 40 percent probability). Prior to application, all ER methods require detailed assessment of reservoir physical and chemical characteristics. Most ER methods also require field testing to evaluate both their technical and economic feasibilities with respect to reservoir and fluid properties of individual fields. Field testing is relatively expensive. Regulatory matters arising from future application of ER technology to Texas oil reservoirs can be well handled by the Railroad Commission of Texas, but will require legislative or regulatory attention to some questions.

25312 Method using overbased branched-chain alkylaromatic sulfonates as waterflood additives. Kerfoot, O.C.; Clark, C.R.; Kennedy, C.D. (to Continental Oil Co.). US Patent 3,933,201. 11 Oct 1974. Filed date 30 Apr 1973. vp.

A process is described for recovering hydrocarbons from a petroliferous formation, comprising: injecting into said formation an effective amount of an aqueous mixture containing from about 0.5 to about 25 weight percent of an overbased waterflood additive; and recovering displaced hydrocarbons from said formation. The waterflood additive consists essentially of a base component selected from the group consisting of NaOH, KOH, LiOH, Na_2CO_3, $NaHCO_3$, NH_4OH, K_2CO_3 and mixtures thereof and a branched-chain alkylaromatic alkylate sulfonate. Preparation method for the alkylaromatic sulfonates is given.

25313 Thermal recovery of viscous oil. Allen, J.C. (to Texaco Inc.). US Patent 3,964,546. 22 Jun 1976. Filed date 21 Jun 1974. 6p.

A method is claimed for recovering low gravity viscous oils and bitumens from a subterranean formation by the simultaneous injection of an oxygen-containing gas and steam so as to control the combustion, followed by a conventional in-situ combustion, after which the formation may be scavenged by water injection. 9 claims, no drawings.

25314 Recovery of heavy hydrocarbons from underground formations. Hujsak, K.L.; Buxton, T.S. (to Amoco Production Co.). US Patent 3,964,547. 22 Jun 1976. Filed date 29 Oct 1974. 6p.

A method of producing highly viscous oil from an underground formation penetrated by a well is claimed. Steam is injected through a first channel into the lower part of the formation. At the same time, previously recovered oil from the formation is injected through the well in a channel surrounding the steam channel to the upper part of the formation. This native oil insulates the formation from the steam and also serves to block the steam from rising in the formation. The heated oil can then be recovered from an adjacent well or injection can be stopped and the oil can be recovered from the well through which the fluid was injected. 2 claims, 1 drawing figure.

25315 Method for oil recovery by flooding with micellar dispersions containing crude oil sulfonates. Schroeder, D.E. Jr.; Plummer, M.A.; Roszelle, W.O. (to Marathon Oil Co.). US Patent 3,964,548. 22 Jun 1976. Filed date 27 Mar 1975. 8p.

Improved oil recovery by flooding subterranean formations with micellar dispersions (comprised of hydrocarbon, water, cosurfactant, electrolyte, and petroleum sulfonate obtained by sulfonating whole or topped crude oil) is obtained by incorporating within the micellar dispersion about 1.5 to about 4.5 wt. percent of active sulfonate groups (e.g. $-SO_3NH_4$ or $-SO_3Na$) which are attached to the petroleum sulfonate. The micellar dispersions of this invention contain an amount of cosurfactant in excess of the amount required to produce a viscosity maximum with the particular micellar dispersion. 19 claims, 3 drawing figures.

25316 Fluid actuated downhole drilling device. Fogle, S.F. (to Texas Dynamatics, Inc.). US Patent 3,964,558. 22 Jun 1976. Filed date 13 Nov 1974. 4p.

A downhole fluid powered mover for use in earth bore holes having a fluid turbine to produce torque and a positive displacement fluid motor to regulate the speed of an output shaft connected to both turbine and motor is claimed. Alternate embodiments include an overrunning clutch to aid in start-up of the turbine and to prevent overspeed of the turbine. 5 claims, 2 drawing figures.

25317 Processes for secondarily recovering oil. Speller, F.N. Jr. (to Esorco Corp.). US Patent 3,964,545. 22 Jun 1976. Filed date 10 Jun 1974. 4p.

A secondary recovery process using injected air to pressurize the formation and maintain mobility of the reservoir oil by diluting the oil with carbon dioxide is claimed. Carbon dioxide is produced as a by-product of air injection, either by auto-oxidation of carbonaceous materials in the reservoir rock, or by ignition of oil in the reservoir. Efficiency of oxidation is observed by testing O_2 content of the effluent gas; it is desirable to hold the oxygen content in the effluent gas to less than 3 percent by volume in the effluent gas. When this content cannot be reached by auto-oxidation, it is necessary to ignite the oil. 5 claims, 1 drawing figure.

25318 Pneumatic impact drilling tool. Bassinger, G. (to Reed Tool Co.). US Patent 3,964,551. 22 Jun 1976. Filed date 20 Sep 1974. 12p.

A pneumatically operated impact drilling tool for rotary drilling includes a reciprocating hammer, an anvil positioned under the hammer and a feeder means extending through the hammer. The drilling tool is connected in a string of drilling pipe and high pressure pneumatic fluid flowing through the drilling pipe operates the impact tool. The feeder directs and times the flow of fluid through ports in the hammer to create a first pressure zone to raise the hammer off the anvil, and a second pressure zone above the hammer to drive the hammer down against the anvil to create an impact on the drill bit. Exhaust ports in the hammer exhaust the fluid from the second pressure zone. 14 claims, 12 drawing figures.

25319 Wave-action undersea-drilling rig. Tornabene, M.G. US Patent 3,964,264. 22 Jun 1976. Filed date 11 Oct 1974. 16p.

In a preferred embodiment, a clamping structure is mounted around a drilling-bit tube and is structured for permitting the clamping structure to rotate in counter-clockwise direction slidably around the drilling-bit tube and to permit the clamping structure to slide upwardly on the drilling-bit tube but to bring about a clamping and gripping of the drilling-bit tube whenever the clamping structure has clock-wise and/or downward force imparted thereto relative to a stationary state of the drilling-bit tube such that clockwise and/or downward force on the clamping structure serves to rotate the drilling tube in a clockwise direction and/or to press and move downwardly the drilling-bit tube, and intimate with the clamping structure there being an outer-cylindrical-surface structure having helical female grooves extending angularly downwardly in each of clockwise and counter-clockwise directions, and there being a circumscribing cylindrical tubular structure having radially-inwardly extending finger-projections shaped for having their respective distal inner ends ride slidably mateably within the helical female grooves such that upward and downward alternate movements of the cylindrical tubular structure imparts rotary motion to the outer-cylindrical-surface structure, and mounted intimately to and around the cylindrical tubular structure there being a spherically-shaped float having a large mass and defining in a substantially horizontal plane and extending around the periphery of the spherical shape thereof consecutive serially arranged uprightly-extending turbine-blade structures positioned and shaped such that water-current force on the turbine-blade structures imparts a clockwise motion to the float. 20 claims, 38 drawing figures.

25320 Pressure operated isolation valve for use in a well testing and treating apparatus, and its method of operation. Farley, D.L.; Barrington, B.Q. (to Halliburton Co.). US Patent 3,964,544. 22 Jun 1976. Filed date 20 Jun 1975. 14p.

A well testing tool is described having a spring whose biasing force is supplemented by the hydrostatic pressure in the well annulus at the testing depth. A method and apparatus for isolating the spring from the pressure in the well annulus are described in which the pressure differential between the well annulus and the testing tool bore is utilized. The isolation of the spring force during subsequent interior bore pressure increases such as during forma-

tion treating operations, can be maintained. An isolation valve is provided whose closing force is generated by isolating the testing tool bore from the well annulus, and then increasing the well annulus pressure above the hydrostatic pressure. The pressure differential thus created is utilized to close the valve. Uni-directional acting means is provided in the isolation valve responsive to the interior bore pressure such that when the interior bore pressure is increased subsequent to the closing of the isolation valve, the unidirectional acting means will not cause the isolating valve to reopen, but will nullify the effect of the subsequent pressure increase such that the valve will remain closed. The opening force is provided by compressing a spring when the valve is closed, thus allowing the isolation valve to reopen when the pressure in the annulus is returned to hydrostatic. An isolation valve is provided which is normally open, which closes only after the well annulus pressure exceeds a reference pressure trapped in the bore of the testing tool by a predetermined amount, and which remains closed during subsequent pressure increases, in the bore of the testing tool.

25321 Drive connector with load compensator. Slator, D.T. (to Brown Oil Tools, Inc.). US Patent 3,964,552. 22 Jun 1976. Filed date 23 Jan 1975. 10p.

Disclosed is a rotary drive assembly for manipulating well pipe. The assembly, which is carried by the traveling block in a drilling derrick, provides means for engaging well pipe by either threaded or non-threaded connection. The threaded connection is used during drilling for imparting rotary motion to pipe forming a drill string. A torque-clamp, connector sub, and pipe guide combination provides male threads within a guiding surface to facilitate the threaded connection to pipe members. A break-out elevator provides a non-threaded connection which is used for manipulating pipe members and for making up or breaking out a connection between threaded pipe segments. A spring and roller assembly in the elevator facilitates the gripping of a pipe segment by the elevator and cushions the impact on the rotary drive assembly when the elevator is used to lift well pipe. Another spring and roller assembly in the drive head permits manual rotation of the drive connector to align the elevator for insertion or removal of a pipe segment.

25322 Sonic fluid level control apparatus. Watson, B.R. US Patent 3,965,983. 29 Jun 1976. Filed date 13 Dec 1974. 8p.

Pump-off control apparatus is claimed for preventing cavitation of a sub-surface pump which provides artificial lift for fluid produced from a fluid bearing strata located downhole in a borehole. A sound wave is focused downhole and travels down the casing annulus where it strikes the liquid surface and rebounds to a receiver located near the well head. The time lapse of the traveling wave is used to measure the relative location of the liquid surface relative to the pump inlet, thereby enabling the control apparatus to shut-in a well before it can encounter a pump-off condition which can cause fluid pounding. 10 claims, 6 drawing figures.

25323 Method and apparatus for actuating a downhole device carried by a pipe string. Jeter, J.D. (to Texas Dynamatics, Inc.). US Patent 3,967,680. 6 Jul 1976. Filed date 1 Aug 1974. 10p.

A combination of means to detect rotation of a pipe string is described and means to detect flow of fluid through a pipe string is utilized to cause down hole apparatus to carry out preferred actions if the sequence of rotation rate change and flow rate change is of one character; other activities are carried out if different sequences occur. Alternately, a choice of several actions to be taken by down hole apparatus may be elected by sustaining a flow condition while rotational conditions are manipulated at the earth surface.

25324 Power generation in underground drilling operations. Russel, M.K.; Russel, A.W. US Patent 3,970,877. 20 Jul 1976. Priority date 31 Aug 1973, United Kingdom of Great Britain and Northern Ireland (UK). 2p.

The electrical power required to drive downhole drilling tools and/or measuring instruments is obtained using means responsive to turbulence in the mud flow past a unit forming part of the drill string. The responsive means may comprise a piezoelectric disc connected to rectifying and smoothing circuits whereby a dc output is obtained.

PROCESSING

REFER ALSO TO CITATION(S) 25214, 25241, 25703

25325 (PB—241901) Demetallization of heavy residual oils. Phase II. Report for Jan—Dec 1974. Chervenak, M.C.; Maruhhnic, P.; Nongbri, G. (Hydrocarbon Research, Inc., Trenton, N.J. (USA)). Feb 1975. Contract EPA-68-02-0293. 79p. NTIS $4.75.

See also PB—227568.

The report gives Phase II results of a study of demetallization of heavy residual oils. Phase I was an experimental laboratory investigation to find a new low-cost demetallization catalyst for high metals, high sulfur residual oils. Phase II utilized the Phase I results to test the effectiveness of a demetallization catalyst when prepared on a commercial scale. The commercial production catalyst was tested for activity and aging characteristics and compared to laboratory prepared catalysts. The report includes descriptions of the catalyst, test units, and operating conditions and procedures. (GRA)

25326 Process for reactivation of iridium-containing catalysts. Paynter, J.D. (to Exxon Research and Engineering Co.). US Patent 3,941,716. 16 Aug 1973. vp.

Process is described for reactivating a reforming catalyst, which includes an iridium component composited with a refractory porous inorganic oxide, previously inactivated by coke deposition thereon during contact with a hydrocarbon feed at hydrocarbon conversion conditions. The catalyst is regenerated by burning at elevated temperatures in the presence of oxygen containing gases to remove accumulated coke deposits therefrom. The improvement comprises: contacting, without interim contact with a substantially halogen-free, oxygen-containing gas at temperatures in excess of about 775°F., a bed of the coke-depleted catalyst in a cycle which includes, in sequence, the steps of (a) contacting the coke-depleted catalyst with hydrogen or a hydrogen-containing gas at a temperature sufficient to reduce the said iridium component and then (b) contacting said reduced catalyst at an elevated temperature from about 550°F to about 1150°F in a reaction zone provided with exposed ferrous metal surfaces with a gas comprising elemental halogen or halogen precursor and water in amount ranging from about 0.1:1 to 15:1 molar ratio of water:halogen, in a non-oxygen containing atmosphere, sufficient to suppress corrosion of the ferrous metal surfaces of the reaction zone and to effect redispersion of the iridium.

25327 Isomerization of aliphatic hydrocarbons. Siskin, M.; Porcelli, J.J. (to Exxon Research and Engineering Co.). US Patent 3,948,761. 25 Feb 1974. Filed date 21 Dec 1971. vp.

An isomerization process is claimed comprising: contacting in a reaction zone and at substantially liquid phase catalyst isomerization conditions including a temperature varying between about 0° and 150°C; a feed stock comprising a component selected from the group consisting of a saturated acyclic hydrocarbon having at least four carbon atoms, a saturated alicyclic hydrocarbon having at least five carbon atoms and mixtures thereof, said feed stock additionally containing a component selected from the group consisting of at least about 1 wppM, based on said feed stock, of sulfur compounds, at least about 0.001 wt. percent, based on said feed stock, of an unsaturated hydrocarbon compound or mixtures thereof; hydrogen at a partial pressure of at least about 5 psig and a catalyst system comprising a metal halide selected from the group consisting of gallium bromides and chlorides and the chlorides, bromides and fluorides of niobium, tantalum, molybdenum or tungsten in combination with at least an equal molar amount, based on the metal halide, of a hydrogen halide selected from hydrogen fluoride, hydrogen chloride, and hydrogen bromide, at least a portion of said metal halide being dissolved in said hydrogen halide.

25328 Hydrodesulfurization with a catalyst formed from an alumina sol containing alpha—alumina monohydrate. Hilfman, L. (to Universal Oil Products Co.). US Patent 3,923,646. 2 Dec 1975. Filed date 13 Dec 1974. 8p.

Sulfur-containing petroleum hydrocarbon fractions are treated at hydrodesulfurization reaction conditions in contact with a catalytic composite comprising a Group VIII metal or metal oxide, a Group VIB metal or metal oxide, and an alumina support or carrier material. The alumina support is characterized by a method of preparation which results in improved hydrodesulfurization activity of the catalytic composite.

25329 Hydrocarbon conversion over activated erionite. Burgess, W.P. (to Mobil Oil Corp.). US Patent 3,925,191. 9 Dec 1975. Filed date 17 Jul 1974. 8p.

This invention is directed to the shape selective conversion of a hydrocarbon charge over H-erionite, both natural and synthetic, which has been activated by exchanging with the ammonium ion as a first step, calcining in steam and exchanging with the ammonium ion. The conversion is conducted in the presence of a hydrogen atmosphere but in the absence of any hydrogenating catalyst such as a metal of the platinum group.

25330 Ebullated bed process. Wolk, R.H. (to Hydrocarbon Research, Inc.). US Patent 3,926,783. 16 Dec 1975. Filed date 13 Mar 1974. 6p.

A process is claimed which prevents the loss of fluidization in an ebullated catalyst bed when two liquid phases are present by adding a solid to the bed which will pass through the bed at a rate greater than the normal catalyst replacement rate for the main material in the bed. This added material will be constructed so as to allow the second liquid phase to preferentially be adsorbed on its surface.

25331 Hydrodesulfurization of residuals. Gregoli, A.A.; Hartos, G.R. (Cities Service Research and Development Co., Cranbury, NJ). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 2, 43-48(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P2.

Residual desulfurization technology using the H-Oil process at the Lake Charles Refinery is described. Essential design features and important parameters considered in residual desulfurization are presented. The flexibility of the H-Oil process is discussed. Desulfurization costs are shown for a variety of residual feedstocks.

25332 Catalyst deactivation due to pore-plugging by reaction products. Newson, E. (Technical Univ. of Denmark, Bygning). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 2, 49-63(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P2.

In trickle-bed hydrodesulfurization the gas and liquid phases pass concurrent downflow over a fixed bed of catalyst. The hydrotreating of residuum oils at elevated temperatures and pressures in this way has revealed the presence of (undesirable) demetallation reactions taking place in parallel with the desired desulfurization reactions. Organometallic constituents of the oil, primarily vanadium, nickel and iron, react out of the oil and combine with hydrogen sulfide to produce solid deposits of metal sulfides. The deposition of the reaction products occur both inter- and intra-particle. The intra-particle deposits decrease the effective diffusivity of the catalyst causing deactivation by a pore-plugging mechanism. A simple model is proposed to take into consideration catalyst deactivation in residuum hydrotreating by metal sulfides build-up within the pores of the catalyst. The effect of the metal sulfides are considered the dominant feature of the deactivation process based on recent evidence from the literature. The demetallation rates used in the model are typical of current commercial practice. Predictions for catalyst life are compared with commercial data.

25333 H-oil desulfurization of heavy fuels. Johnson, A.R.; Wolk, R.H.; Hippeli, R.F.; Nongbri, G. (Hydrocarbon Research, Inc., New York). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 2, 64-81(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P2.

Several recent advances in the H-Oil process make it practical to produce fuel oils meeting the new stringent sulfur requirements down to 0.3 weight per cent. This can be accomplished on a broad range of feedstocks including high sulfur/low metal Middle East residues as well as the high metal content Venezuelan stocks. The design aspects of a multi-purpose plant having the capability of processing this wide range of materials are discussed, and processing costs are developed as functions of feedstock and product sulfur level.

25334 Method for controlling regenerator temperature in a fluidized cracking process. Bittensky, J.S.; Dillingham, E.W.; Menzies, W.R. III; Pratt, R.E. (to Texaco Inc.). US Patent 3,966,587. 29 Jun 1976. Filed date 23 Dec 1974. 12p.

An improved method is disclosed for controlling the temperature of the fluidized dense catalyst phase of the regeneration zone in a fluid catalytic cracking unit, wherein the coke laydown in the reaction zone is at a level such that the coke concentration of the partially deactivated catalyst from the reaction zone is not sufficient to provide the heat required to maintain the controlled temperature in the fluidized dense catalyst phase of the regeneration zone. In this method, torch oil is added to the partially deactivated catalyst in the spent catalyst transfer line in an amount such that the catalyst charged to the regeneration zone contains sufficient combustible material to provide the heat necessary to maintain the fluidized dense catalyst phase of the regeneration zone at the controlled temperature. Also, as a part of this improved method, the flow of oxygen-containing regeneration gas to the regeneration zone is regulated to provide sufficient oxygen to effect substantially complete combustion of the coke and torch oil to carbon dioxide and to provide an oxygen concentration in the regeneration flue gas within the range of from about 1 to about 10 mol percent. Maintaining the oxygen concentration in the flue gas within this range results in a flue gas having a carbon monoxide content of about 500 ppM, or less, and preferably 10 ppM or less. 8 claims, no drawings.

25335 Method for upgrading heavy petroleum type stocks. Owen, H.; Venuto, P.B. (to Mobil Oil Corp.). US Patent 3,966,586. 29 Jun 1976. Filed date 31 Jul 1974. 10p.

Heavy hydrocarbon feeds are dispersed in solvent ethers and product recycle fraction prior to catalytic cracking thereof with acidic compositions comprising particular crystalline zeolite catalyst composition. The solvent ethers are provided by reacting process olefins with methanol to produce low and high molecular weight ethers separately.

25336 Catalytic hydrodesulfurization. Beaty, W.R. Jr. (to Continental Oil Co.). US Patent 3,966,588. 29 Jun 1976. Filed date 14 Jan 1975. 8p.

A process and catalyst is claimed for converting hydrocarbon oils to desirable components by contacting said oils in the presence of hydrogen under hydrocarbon conversion conditions with a catalyst comprising a catalytic amount of a catalytic metal supported on gamma alumina. 3 claims, 4 drawing figures.

25337 Desulphurization of gasoline by metallic sodium. Reggel, L.; Blaustein, B.D.; Delle Donne, C.L.; Friedman, S.; Steffgen, F.W.; Winslow, J.C. (Pittsburgh Energy Research Center). *Fuel;* **55**: No. 3, 170-172(Jul 1976).

Catalytic converters installed in 1975-model automobiles oxidize sulphur dioxide present in the exhaust gas to a sulphuric acid mist. This may constitute a serious health hazard. Sulphur can be removed from gasoline, down to any desired level, by the use of sodium metal at 250—325°C. Hydrogen is not needed. Sodium can be used to desulphurize petroleum fractions before they are converted to gasoline. Jet-aircraft fuels can also be desulphurized by sodium treatment.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 25330, 25960

25338 (BERC/PPS—76/3) **Motor gasolines, Winter 1975—76.** Shelton, E.M. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Jun 1976. 76p. Dep. NTIS $5.00.

Data for 2,699 samples of motor gasoline, from service stations throughout the country, were collected and analyzed under agreement between the Bartlesville Energy Research Center and the American Petroleum Institute. The samples represent the products of 56 companies, large and small, which manufacture and supply gasoline. These data are tabulated by groups according to brands (unlabeled) and grades for 17 marketing areas (districts) into which the country is divided. A map in this report shows marketing areas and sampling locations. The report also includes charts indicating the trends of selected properties of motor fuels since 1946 and three bar graphs illustrating the variations of octane numbers in the present survey by frequency for all samples represented. The averages for the antiknock (octane) index [(R + M)/2] of gasolines sold in this country were 88.2, 89.7, and 95.2 for unleaded, regular, and premium grades of gasolines, respectively.

25339 X-ray peak area as a method of characterizing petroleum cokes. Allred, V.D. (Marathon Oil Co., Denver). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 1, 1-10(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P1.

A correlation between the area (height by average width) of the 002 x-ray diffraction peak of calcined petroleum coke and the linear CTE (Coefficient of Thermal Expansion) for graphite manufactured from the coke has been developed. This procedure permits classification of a petroleum coke as to its potential use and value without having to prepare a graphite test specimen. The effect of calcining temperature on the diffraction peak area has been investigated over a wide temperature range (1200-2600°F) for typical regular and premium cokes. As a result, it has been discovered that the area of the 002 peak remains nearly constant over a considerable temperature range (predominantly the 2400 to 2600°F interval). This observation is somewhat unexpected since the values for both the diffraction line broadening (peak width) and

the intensity (peak height) change considerably with both temperature and time. By taking advantage of the constant peak area phenomenon, considerable flexibility is permitted in the heat treatment of given coke sample prior to evaluation.

25340 Combination process for the conversion of heavy distillates to LPG. Hilfman, L. (to Universal Oil Products Co.). US Patent 3,963,600. 15 Jun 1976. Filed date 9 Jun 1975. 8p.

Maximum conversion of heavy distillates to LPG is achieved through a combination process involving two-stage hydrocracking. 9 claims, no drawings.

25341 Method of calcining coke in a rotary kiln. Farago, F.J.; Sood, R.R.; Stokes, D.M. (to Alcan Research and Development Ltd.). US Patent 3,966,560. 29 Jun 1976. Filed date 6 May 1974. 14p.

In the calcination of petroleum coke in a rotary kiln, air is controllably supplied internally of the kiln to burn the removed volatiles, as by selection or adjustment of the amount of such air and of the speed of coke travel down the kiln, so that all or nearly all of the heat for calcining the coke is provided by such combustion, and so that a suitably high temperature is reached for effective calcination at an efficiently large feed rate of coke. A special feature is to maintain a significantly long travel time of the coke from a region of intense calcining activity to the product discharge end of the kiln. High production rates, of coke calcined well and uniformly, are economically attained, with ease of control and with unusual stability of kiln operation.

25342 Production of lubricating oils. Yan, T.Y. (to Mobil Oil Corp.). US Patent 3,968,023. 6 Jul 1976. Filed date 30 Jan 1975. 6p.

Residual oils are upgraded to lube oil base stocks by a combination process involving deasphalting, solvent extraction and hydrocracking arranged to particularly promote the efficient production of lube oil products. 5 claims, 1 drawing figure.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 25963

25343 (COM—75-10543) **Maritime fuel price and availability, 1975—2000. Final report.** (Tetra Tech, Inc., Arlington, Va. (USA)). 12 Apr 1975. Contract MA-4-37121. 219p. (TETRAT-A—74-430-117). NTIS $7.25.

Prepared in cooperation with Chase Manhattan Bank, New York.

Presented is an in-depth analysis of the interrelationship between marine fuel and the total energy market and the impact of the recent price and conservation developments on the future price and availability of marine fuels. Price and availability of marine fuels in the U.S. for the near term (1975—1985) and the far term (1985—2000) are projected. (GRA)

25344 Supply of oil for future U.S. needs and the subsequent effects on the environment. Morrell, G.P.; Oliver, D.R.; Reed, J.I. (Dept. of the Interior, Washington, DC). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 1, 71-87(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P1.

Throughout the present decade the U. S. is going to become increasingly dependent on foreign oil supplies. Some factors that are causing our requirements for imported oil to increase rapidly are the lack of development of our domestic natural gas production, environmental constraints on the use of coal as an alternate source of energy, and a retardation in the development of Alaskan oil and offshore leases. Latest projections show that U. S. dependence on foreign oil could be 46 percent of total oil demand in 1980 compared to 23 percent for the year 1971. The corresponding imports for 1980 could be 10,300 MB/D compared to 3,800 MB/D imported for the calendar year 1971. About 78 percent of the imported oil in 1971 was from the Western Hemisphere and 22 percent from the Eastern Hemisphere. Most of the increase in imports beyond today's level will come from the Persian Gulf. This oil is typically high sulfur (greater than 2 percent sulfur) oil. A factor that is of primary importance is the form in which the oil will be imported, that is, crude oil or refined products. Import policy will dictate whether most of the additional imports will be crude oil or refined products such as residual fuel oil. The policy will also have considerable bearing on the configuration of domestic refineries. It would appear that major modifications in refinery configuration resulting from changes in oil import policy could, in the long run, diminish the negative effects that future refinery capacity could possibly have on the surrounding environment as well as increasing the domestic production of clean fuels.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 25281, 26498, 26499, 26502, 26503, 26504, 26505, 26507, 26509, 26514, 26516, 26517, 26525

25345 (PB—241261) **Sulphur compound emissions of the petroleum production industry.** (Kellogg (M.W.) Co., Houston, Tex. (USA)). Dec 1974. Contract EPA-68-02-1308. 170p. NTIS $6.25.

The report gives results of a study of sulfur compounds emissions from the Permian Basin and the Smackover Formation, two areas that represent about 80% of the sulfur emissions from oil and gas fields in the U.S. SO_x emissions from these two areas are estimated to be 664,000 short tons per year, of which 384,000 short tons per year are from Claus plant tail gases. H_2S emissions are estimated to be 9000 short tons per year. The report lists the plants studied and tabulates the production of sulfur emissions by counties. (GRA)

25346 Reclaiming used motor oil. Johnson, M.M. (to Phillips Petroleum Co.). US Patent 3,930,988. 24 Feb 1975. vp.

A process for reducing the ash content of used lubricating oils comprises: (a) contacting used lubricating oil with an aqueous solution of ammonium sulfate and/or ammonium bisulfate under conditions of temperature and pressure sufficient to react said ammonium sulfate and/or ammonium bisulfate with metal-containing components present in the used lubricating oil and form metal-containing solids; (b) allowing the reaction mass of (a) to separate into an oil phase and an aqueous phase containing said solids; and (c) recovering the oil phase as a marketable low-ash oil product.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 25337, 26184, 26433, 26470, 26486, 26487, 26490, 26492, 26493, 26500, 26502, 26561, 26583, 26584

25347 (AD-A—010000) **Detection and identification of oil spills by remote fluorometric systems. Final report.** Eldering, H.G.; Hornig, A.W.; Webb, W.A. (Baird Atomic, Inc., Bedford, Mass. (USA)). Sep 1974. Contract DOT-CG-31529-A. 158p. NTIS $6.25.

An Oil Spill Surveillance System based on remote measurement of petroleum oil fluorescence was designed, built, and tested. This system is capable of oil spill detection and oil classification in a commercial harbor environment at a range in excess of 100 meters during hours of darkness. The system functions at viewing angles varying from vertical to within 10 degrees of the horizon and may be programmed for area detection scanning. Fluorescence spectra of a range of oils are presented including corrected spectra presented in a two-dimensional format. General classification of oil type through fluorescence measurements is discussed. A method for the estimation of film thickness from remote fluorescence measurement is described and a polarization technique for discriminating between marine and oil fluorescence is presented. (GRA)

25348 (AD-A—010199) **Development of boat and helicopter deployable oil slick sampler. Final report, Jun—Aug 1972.** Allen, A.A.; Fausak, L.E. (Marconsult, Inc., Santa Monica, Calif. (USA)). May 1975. Contract DOT-CG-24828. 54p. NTIS $4.25.

MARCONSULT, Inc., has developed a device for the sampling of waterborne oil films ranging from 0.001 to 10 mm in thickness. The prototype device is a modified stainless steel testing sieve, normally used in sediment size analysis, into which is placed a sheet of sorbent material. The sampler is suspended from a cable or chain harness and is dipped into an oil slick; the oil film adheres to the stainless steel sieve screen and is absorbed by the sorbent sheet. After retrieval, the sampler is immediately sealed with a clean lid and bottom pan to prevent contamination of the oil sample, and thereby also becomes its own sample container. The results of a limited testing program indicate that the device will collect in excess of the required 50 ml of oil from fresh, thick films, but that samples of five to ten milliliters are more typical of very thin or weathered oil films. (GRA)

25349 (LSU-SG—73-01, pp 17-24) **Threnody concerning the biodegradation of oil in natural waters.** Floodgate, G.D. (Marine Science Labs., Menai Bridge, England). 1973.

In Microbial degradation of oil pollutants.

This essay has been entitled a threnody. It is not by any means a song of despair. Rather, it is largely a plea for a more ecological approach to the problem of oil degradation—an insistence that when oil is spilled into water, the physics, chemistry and biology of the water must be taken into account. New ideas and new apparatus are required such as Gibbs has used in his semi-open system as a first approach to the problem, and its later developments. Other possible ways of measuring heterotrophic activity, as yet unexplored in oil degradation, were suggested by Strickland. Also implied in the present paper is that research on this topic requires the cooperation of microbiologists, oil chemists and marine chemists. It is also a plea for recognition of our ignorance, and of the complexity of the problem. Broad generalizations, whether optimistic or pessimistic, are out of place. Our knowledge of what part microorganisms play in the ecology of estuaries, coastal waters and the deep oceans is at best sketchy. A great deal of hard, but exciting work lies ahead.

25350 (LSU-SG—73-01, pp 81-87) **Considerations in application of microorganisms to the environment for degradation of petroleum products.** Cobet, A.B.; Guard, H.E.; Chatigny, M.A. (Univ. of California, Berkeley). 1973.

In Microbial degradation of oil pollutants.

Considerations in the use of microbial preparations for the degradation of oil pollutants are presented. Besides obvious effects of nutrients on the environment, factors associated with emulsification of the oil pollutant, i.e., increased solubility and toxicity of the residue, and factors in application of the preparation (aerosolization) are discussed.

25351 (LSU-SG—73-01, pp 89-94) **Studies on the degradation of petroleum by filamentous fungi.** Perry, J.J.; Cerniglia, C.E. (North Carolina State Univ., Raleigh). 1973.

In Microbial degradation of oil pollutants.

Studies were initiated in this laboratory on the degradation of petroleum by microorganisms maintained in stock culture and originally selected for their ability to grow on hydrocarbon substrates. The results suggested that many of the constituent parts of complex petroleum could be utilized by these organisms but none could mineralize a significant part of the oil. It was evident, however, that the fungi available were superior to bacteria in the amount of growth attained on various crude oils. Tests with microbes isolated by enrichment with crude oil as substrate confirmed that fungi were more efficient in our system in mineralizing petroleum hydrocarbons. This report is concerned with several aspects of these hydrocarbon degradation studies.

25352 (LSU-SG—73-01, pp 95-104) **Microbial degradation of crude oil and the various hydrocarbon derivatives.** Liu, D.L.S. (Canada Centre for Inland Waters, Burlington, Ont.). 1973.

In Microbial degradation of oil pollutants.

The utilization of various petroleum products by a crude oil-grown bacterial culture has been studied using manometric and gas chromatographic techniques. A comparison of the gas chromatogram before and after growth showed that the n-alkane fraction had been preferentially utilized. Manometric techniques demonstrated that the crude oil-grown cells could also rapidly degrade n-alkanes, hydrocarbon alcohols, methyl ester of fatty acids and alkylbenzenes.

25353 (LSU-SG—73-01, pp 105-125) **Microbes and petroleum: perspectives and implications.** Finnerty, W.R.; Kennedy, R.S.; Lockwood, P.; Spurlock, B.O.; Young, R.A. (Univ. of Georgia, Athens). 1973.

In Microbial degradation of oil pollutants.

An ultra-structure study of acinetobacter sp grown on paraffinic and olefinic hydrocarbons demonstrated cytoplasmic sequestering of hydrocarbons. Induced membrane synthesis was additionally demonstrated as a result of hydrocarbon metabolism. Increased cellular and extracellular lipid synthesis was qualitatively and quantitatively documented during hydrocarbon metabolism. These studies serve to emphasize our lack of detailed knowledge concerning the consequences which may arise from this relationship.

25354 (LSU-SG—73-01, pp 141-146) **Marine hydrocarbonoclastic bacteria: types and range of oil degradation.** Soli, G. (Michelson Labs., China Lake, CA). 1973.

In Microbial degradation of oil pollutants.

Marine bacterial isolates were characterized on the basis of their ability to attack hydrocarbons in a complex synthetic mixture. It is possible to outline the oil degradation range of the organisms by properly balancing the various components. The degree of specialization and adaptation to hydrocarbon oxidation was determined indirectly with different nitrogen sources.

25355 (LSU-SG—73-01, pp 147-152) **Biodegradation of oil in seawater: limiting factors and artificial stimulation.** Bartha, R.; Atlas, R.M. (Rutgers—the State Univ., New Brunswick, NJ). 1973.

In Microbial degradation of oil pollutants.

The limiting factors of petroleum biodegradation in seawater were systematically evaluated. In the surveyed coastal waters, hydrocarbon oxidizers were found to be abundant, but their substrate ranges relatively restricted. Besides lowering the biodegradation rates, low water temperatures caused long lag periods due to retention of volatile inhibitors in crude oil. Nitrogen and phosphorus were found to be severely limiting. Addition of these nutrients dramatically increased oil biodegradation both in laboratory and in field experiments. An oleophilic fertilizer formula for use on floating oil slicks is described.

25356 (LSU-SG—73-01, pp 163-170) **Bacterial degradation of petroleum materials in low temperature marine environments.** Traxler, R.W. (Univ. of Rhode Island, Kingston). 1973.

In Microbial degradation of oil pollutants.

Samples of sediments and water were obtained from Chedabucto Bay, Nova Scotia, and from Narragansett Bay, Rhode Island. Isolation plates were incubated at enrichment temperature and the characteristics of each colony type were determined. A representative of each hydrocarbon-utilizing colony from each enrichment substrate and from each temperature was selected for determination of its hydrocarbon utilization profile. Forty-nine hydrocarbon-utilizing bacteria from Nova Scotia and 72 from Narragansett Bay were isolated. Tables are presented to show per cent substrate utilization of naphthalene, fuel oil, and kerosene isolates after 8 days at different temperatures for the following substrates: hexane, dodecane, hexadecane, iso-octane, methylcyclohexane, xylene, hexylbenzene, and naphthalene. The data demonstrate that marine facultative psychrophiles can be isolated that readily utilize a variety of aliphatic, cyclic, and aromatic hydrocarbons. (HLW)

25357 (LSU-SG—73-01, pp 171-184) **Hydrocarbon biodegradation in Alaskan waters.** Robertson, B.; Arhelger, S.; Kinney, P.J.; Button, D.K. (Univ. of Alaska, College). 1973.

In Microbial degradation of oil pollutants.

Populations of hydrocarbon-oxidizing organisms were of the order of 1/cc in Alaska's Cook Inlet and Port Valdez, less in the Arctic Ocean. Distribution decreased with salinity in Cook Inlet and with depth in Port Valdez. In situ oxidation of ^{14}C-dodecane (91 μg C/liter) started within hours and proceeded at a rate of 1 μg/liter-day. Storage of Cook Inlet crude oil for four years in sea water at 10 C effected removal of most visible components. Mixing had a major effect on oil slick stability. The solubilization process was little affected by added silt, a major component of many Alaskan estuaries. Isolated organisms had unique preferences for various components of kerosene, emulsified crude oil and responded in a normal way to incubation temperature, E/sub a/ 14.5 to 16 Kcal/mole. Some effects of crude oil inhibition are discussed. Calculations show that motility, particularly in combination with chemotaxis, is necessary for rapid slick inoculation.

25358 (LSU-SG—73-01, pp 185-197) **Microbial ecology and the problem of petroleum degradation in Chesapeake Bay.** Colwell, R.R.; Walker, J.D.; Nelson, J.D. Jr. (Univ. of Maryland, College Park). 1973.

In Microbial degradation of oil pollutants.

Information obtained on the ecology of mercury-metabolizing bacteria in Chesapeake Bay has provided interesting comparisons with the petroleum-degrading microbial populations. Petroleum degradation studies are being done to obtain a seasonal incidence, as well as species distribution of petroleum-degrading microorganisms in Chesapeake Bay. From analyses of water and sediments collected at two stations in Chesapeake Bay it was found that the concentration of petroleum in an oil polluted site in Baltimore Harbor was ca five times greater than in Eastern Bay. The numbers of petroleum-degrading microorganisms, measured by direct and replica plating, in the water and sediment samples were related to the concentration of oil in each sample. Total yields of petroleum-degrading microorganisms grown on an oil substrate were greater for those organisms exposed to oil in the natural environment. Microorganisms isolated from water and sediment samples collected in Baltimore Harbor grew on substrates representative of the aliphatic, aromatic and refractory hydrocarbons. From analyses of species distribution, it was observed that a hydrocarbon-utilizing fungus, Cladosporium resinae, and actinomycetes were predominant among the hydrocarbon-utilizing isolates. Microbial degradation of petroleum in Chesapeake Bay appears to be mediated by the autochthonous microbial flora. The objective of work in progress is to determine whether a seasonal fluctuation in the petroleum-degrading microflora occurs in the Bay.

25359 (LSU-SG—73-01, pp 221-228) **Impact of oil on marshland microbial ecosystems.** Meyers, S.P.; Ahearn, D.G.; Crow, S.; Berner, N. (Louisiana State Univ., Baton Rouge). 1973.

In Microbial degradation of oil pollutants.

Alterations in the microbial community concurrent with oil intrusion and massive deposition of petroleum effluents along the Louisiana coast were studied. Investigations were concerned with effects on the basic food web of the Spartina marshland ecosystem. Microorganisms found in the marshland included yeasts, molds, cellulolytic fungi, and bacteria. The metabolic activities of these organisms in relation to oil pollution are discussed. (HLW)

25360 (LSU-SG—73-01, pp 229-231) **Production and characterization of emulsifying factors from hydrocarbonoclastic yeast and bacteria.** Guire, P.E.; Friede, J.D..; Gholson, R.K. (Oklahoma State Univ., Stillwater). 1973.

In Microbial degradation of oil pollutants.

A hydrocarbonoclastic yeast (Candida) and bacterium (Pseudomonas) were found to release into the culture medium heat-stable factor(s). The latter were effective over a wide range of pH in emulsifying hydrocarbons and crude oils in water.

25361 (LSU-SG—73-01, pp 259-264) **Sublethal effects of the water soluble component of oil: chemical communication in the marine environment.** Takahashi, F.T.; Kittredge, J.S. (Oregon State Univ., Corvallis). 1973.

In Microbial degradation of oil pollutants.

Intertidal crabs, pachygrapsus crassipes, were exposed to water-soluble extracts of two crude oils. Both the feeding response and the mating response of the males when exposed to the sex pheromone were inhibited. The recovery period varied from three to six days. The seawater extracts of the crude oils were diluted 10:1 and 100:1. Each of these was effective in inhibiting chemoreception in the crabs following a 24 hr exposure. If it is assumed that 1 percent of the crude oil films was extracted into the seawater, it can be concluded that the threshold concentration of total water solubles effective in inhibiting chemoreception is below 10^{-8}. Observations indicate that the sublethal effects of the water-soluble components of petroleum products may alter species survival. It was shown that both reproduction and growth are sensitive to minute concentrations of aromatic hydrocarbon pollution. (HLW)

25362 (LSU-SG—73-01, pp 291-309) **Bacterial seeding to enhance biodegradation of oil slicks.** Miget, R. (Univ. of Texas, Port Aransas). 1973.

In Microbial degradation of oil pollutants.

Evaluations have been made to determine the feasibility of adding selected hydrocarbon-oxidizing bacteria and required nutrient salts to an oil slick to enhance biodegradation of the polluting hydrocarbon. Fifty active mixed cultures were isolated. Culture characteristics including cell morphology, temperature tolerance, and resistance to chemical dispersants were determined. Biodegradation of adsorbed vs. non-adsorbed oil was compared, and media for mass cultivation of organisms was developed. Simulated field, or tank, experiments showed the effectiveness of microbial seeding varied more with the type and quantity of crude oil used than with such factors as inoculum density or nutrient salt concentration. Initial 24-hr oil losses were generally twice as large in bacterial seeded tanks relative to uninoculated controls. Biological oxygen demand and total organic carbon analyses of tank water indicated little metabolic product pollution of the water.

25363 (NTIS/PS—75/710) **Oil water separators. A bibliography with abstracts. Search period covered: 1964—August 1975.** Smith, M.F. (National Technical Information Service, Springfield, Va. (USA)). Sep 1975. 114p. NTIS $25.00.

The 89 citations cover federally-sponsored research on these devices primarily for oil pollution control; centrifuge separators, coalescers, and filters are included. Oil recovery from oil spills and separation from ballast and bilge water are also cited. See also NTIS/PS-75/542, Oil Pollution Removal and NTIS/PS-75/595, Oil Pollution Detection and Sensing.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 25963

25364 (NP—20499/P1) **Proposed 1975 Outer Continental Shelf oil and gas general lease sale, offshore Southern California: OCS sale No. 35. Volume 1. Draft environmental statement.** Bankland, C. (Bureau of Land Management, Washington, D.C. (USA)). 1975. 807p. Bureau of Land Management, Washington, DC.

Volume 1 comprises descriptions of the proposal and the environment. The environment description covers geologic framework, climate of coastal southern California and adjacent waters, physical oceanography, chemical oceanography, biological oceanography, important marine associated habitats, human utilization, environmental problems, and historical and projected economic growth. (LK)

25365 (NP—20499/P2) **Proposed 1975 Outer Continental Shelf oil and gas general lease sale, offshore Southern California: OCS sale No. 35. Volume 2. Draft environmental statement.** Bankland, C. (Bureau of Land Management, Washington, D.C. (USA)). 1975. 510p. Bureau of Land Management, Washington, DC.

Volume 2 comprises the environmental impact of the proposed sale, mitigating measures included in the proposed action, unavoidable adverse environmental effects, relationship between local short-term use and maintenance and enhancement of long-term productivity, irreversible and irretrievable commitment of resources, alternatives to the proposed action, and consultation and coordination with others. (LK)

25366 (NP—20499/P3) **Proposed 1975 Outer Continental Shelf oil and gas general lease sale, offshore Southern California: OCS sale No. 35. Volume 3. Draft environmental statement.** Bankland, C. (Bureau of Land Management, Washington, D.C. (USA)). 1975. 718p. Bureau of Land Management, Washington, DC.

Volume 3 contains the 23 appendices for the Draft Environmental Impact Statement. (LK)

25367 (NSF-RA-N—74-241) **Legal aspects of state-owned oil and gas energy resources. Project L/R-5, final report.** Boyd, D.S. (Texas Governor's Energy Advisory Council, Austin (USA)). 31 Oct 1974. 84p. National Science Foundation, Washington, DC.

Anyone who supposed that an analysis of the legal aspects of state-owned oil and gas would lead to a panacea in the energy field will be disappointed. This relative inability of state-owned oil and gas resources to be used to effectuate dramatic changes in energy policy emanates from three inherent limitations: (1) the fact that the state does nothing but own and lease the oil and gas; the state does not engage in the production, transportation, processing, or distribution of oil and gas and its products; (2) the benefit of the resources are dedicated by the state constitution to education, in perpetuity, and not to energy; and (3) state-owned oil and gas production amounts to only a small percentage (about 9 percent) of state-wide production.

25368 (USC-SG—1-74) **Outer Continental Shelf development hearings. Observations and review of U.S. Senate Commerce Committee national ocean policy study, Santa Monica, California, September 27—28, 1974.** Leopold, L.C.; Hudgins, S.J. (University of Southern California, Los Angeles (USA)). 11 Oct 1974. 27p. University of Southern California, Los Angeles.

A summary and review of the Outer Continental Shelf Development hearings are presented. (LK)

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 25962

STORAGE

25369 (AD-A—010348) **Concept analysis: offshore breakwater-oil storage system. Miscellaneous paper.** Peraino, J.; Plodowski, T. (Raymond Technical Facilities, Inc., New York (USA)). Apr 1975. Contract DACW72-73-C-0005. 68p. NTIS $4.25.

The study attempts to arrive at a satisfactory method of providing a prompt and efficient answer to the fast-growing need for deep-draft berthing facilities along the U.S. east coast. The general concept of large hollow precast floating units towed to the site, and sunk into position lends itself particularly to using the hollow interiors as storage space for liquid bulk cargo in large quantities. Since the trend for more economical transportation of petroleum products is by use of large deep-draft carriers, the combination breakwater-oil storage system is a possible solution. Assumptions were made as to probable site conditions, i.e., water depths, sea conditions, bottom conditions, and a preliminary design developed for the units. Various construction procedures were studied and compared from both technical and construction cost aspects. (GRA)

NATURAL GAS

REFER ALSO TO CITATION(S) 25197, 25199, 25304, 25942, 25959, 25961, 25987

RESERVES

REFER ALSO TO CITATION(S) 25965

EXPLORATION

REFER ALSO TO CITATION(S) 25364, 25365, 25366, 25368, 25964

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 25308, 25316, 25318

25370 (MERC/TPR—76/3) **Drilling a directionally deviated well to stimulate production from a marginal reservoir in southern West Virginia. Technical progress report.** Overbey, W.K. Jr.; Ryan, W.M. (Energy Research and Development Administration, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Jul 1976. 37p. Dep. NTIS $4.00.

A deviated well was drilled in a direction selected to maximize the number of natural fractures that might be encountered and to evaluate the deviated well concept for producing gas from the economically marginal Upper Devonian Shale in the eastern United States. The well was drilled to a depth of 4,678 feet (true vertical depth of 3,928 feet) with the average deviation from vertical through the shale section being 40°7′. The shale was completed open hole and was shot with 18,700 pounds of gelatin explosive from 2,900 feet to 4,678 feet. Five days after treatment the well exhibited an open flow of 103 Mcfd. Following several months of shut-in, the wellhead pressure had increased to 552 psi and the well was put on production. Production of gas for the three months following shut-in was a total of 1801 Mcf.

25371 (NSF-RA-N—74-252) **Assessment of enhanced recovery technology as a means for increasing natural gas recovery in Texas. Project N/T-7, final report.** Lohse, E.A. (Gulf Universities Research Consortium, Houston, Tex. (USA)). Dec 1974. 43p. (GURC—142). National Science Foundation, Washington, DC.

For Governor's Energy Advisory Council of Texas.

Enhanced recovery (ER) technology applied to natural gas reservoirs consists of pumping a special fluid into the well bore with sufficient pressure and volume to create fractures radiating out from the well bore through the reservoir, thereby increasing the surface area through which the gas can drain out of the rock. Increased drainage area produces an increased rate of production from reservoirs whose permeabilities are too low (i.e., less than 0.1 millidarcy) for commercial production by conventional recovery methods. Hydraulic fracturing is the only available gas ER technology. Non-associated gas (dry gas) is the product. Gas estimated to be available only by ER technology amounts to 35 TCF already discovered and 90 TCF believed probably to exist. The total 125 TCF of tight gas would yield 62.5 TCF proved reserves at 50 percent recovery. Application of ER technology is limited more by economic factors than by technology itself. No environmental or regulatory problems exist other than questions of unitization and pooling. The Texas Railroad Commission is experienced and capable of handling issues related to increased use of gas ER technology.

25372 **Recovery of natural gas during solution mining of an underground salt deposit.** LaFortune, R.G.J. (to Diamond Shamrock Corp.). US Patent 3,934,650. 23 Sep 1974. Filed date 18 Dec 1972. vp.

The method of recovering natural gas contained in an underground salt deposit comprises injecting water into the underground salt deposit and contacting the gas-containing salt deposit with injected water, thus obtaining a gas-containing brine solution; withdrawing the brine solution from the underground salt deposit thereby forming brine clouded by very finely divided and substantially uniformly dispersed incipient gas bubbles; passing the clouded brine through a fibrous filter element disposed within a filter zone, said element having a fiber density sufficient to provide a pressure drop for said brine across said filter element of not substantially below about 20 p.s.i.g., and containing in the element natural and synthetic fibers maintained in said filter zone at least in part by resin binding, wherein said fibers are selected from the group consisting of natural wool, cellulose, and rayon, and said fibers are bound together by a synthetic, water-insoluble resin; withdrawing clarified, gas-depleted brine from the downstream region of said filter zone; withdrawing gas from said filter zone and away from the resulting clarified brine; and, collecting said gas overhead from said filter zone.

HEALTH AND SAFETY

25373 (NP—20587) **Seventh annual report on the administration of the Natural Gas Pipeline Safety Act of 1968 [for] calendar year 1974.** (Department of Transportation, Washington, D.C. (USA)). 15 Apr 1975. 50p. Dept. of Transportation, Washington, DC.

This report on the administration of the Natural Gas Pipeline Safety Act of 1968 is prepared in accordance with the requirements of Section 14 of the Act. The Act provides for Federal safety regulation of those facilities utilized in the transportation of natural and other gases by pipeline, or gas storage, in or affecting interstate or foreign commerce. The OPS has the responsibility for safety regulation of all natural gas pipelines which are subject to the requirements of the Act. This involves more than 2,100 operators of the nation's gas pipeline network of approximately 1.43 million miles including some 70,000 miles of gathering lines, 265,000 miles of transmission pipelines, and 660,000 miles of distribution mains plus an additional 440,000 miles of gas service lines. These gas pipeline systems transport more than one-third of the nation's energy supply while serving approximately 44.2 million customers. OPS regulatory programs are designed to assure safety in the design, construction, testing, operation, and maintenance of gas pipelines. These activities promote public safety and also help to provide an economical, dependable source of vitally needed energy to residential, commercial, and industrial consumers. In addition to the DOT's gas pipeline safety activities, the OPS has been delegated the Department's safety responsibilities over liquid pipelines operated by carriers engaged in interstate commerce. Some 240,000 miles of such liquid pipelines transport crude oil, petroleum products, liquefied petroleum gases, and anhydrous ammonia.

25374 (BNWL-tr—179) **Some practical investigations about odorizing. Smell intenseness of the various gases.** Borelli, M.F.; Angleraud, O. Translated from *C. R. Congr. Ind. Gaz.*; **82**: 862-904(1965). 81p. Dep. NTIS $5.00.

The first section of this paper is devoted to the definition of the terms peculiar to measuring smells: limits of perceptibility, intenseness of smell, odorizing power, familiarization, safety factor, and exposition of the basic law of Weber which allows us to estimate the intenseness of smell and the additive properties. These indications define more accurately and completely the notion of "odorizing power calculated on the concentration of the odorant at the threshold of perception, the only determination carried out previously. Moreover, some tests are defined which allow to judge whether a gas is smelling enough or not, taking into account the dangers it presents for the user. Lastly, some methods are indicated which make it possible to calculate the amount of odorant to be added at a given gas in terms of the risk that should be averted, explosion or toxicity. The second section of the statement gives a comprehensive description of the Italian practical method of measuring the intenseness of smell, adopted by "Gaz de France", using a test room and odorometers of which a number of designs were used for comparison. Then the experimental investigations carried out at the laboratory and when operating are dealt with. The diagrams about smelling intenseness are quoted as examples. The results of measuring the transmission of smell along the pipelines, either coated with paint or treated with a view to protection against corrosion, together with the complaints expressed by users and the strength of odorization of the gases are quoted. Lastly, the problem of odorant selection is examined. A selection can be made from the properties of its chemical components and from its own properties as an odorant.

MARKETING AND ECONOMICS

25375 **Gas supplies of the United States: present and future.** Zareski, G.K. (Federal Power Commission, Washington, DC). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **17**: No. 1, 49-66(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P1.

A forecast of the availability of natural gas by the Staff of the Federal Power Commission covering the 20-year period from the present to 1990 indicates that the nation's projected gas supplies will be inadequate to meet current projections of future demand. Domestic production is projected to peak in the seventies and decline thereafter. The future role of supplemental sources of gas supply which must be developed in response to the increasing demand for gas is considered and the likely timing and quantitative contribution of the various supplemental sources to total natural gas supply is projected. The major supplementary sources considered are pipeline imports, liquefied natural gas, synthetic gas from coal and gas from Alaska. The availability of supplemental gas supplies in the future is expected to play an increasingly important role in the gas supply position of the nation and by 1990 may provide about 40 percent of the gas consumed.

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 26499

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 25364, 25365, 25366, 25367, 25368, 25377

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 25373, 25379

25376 (NTIS/PS—75/464) **Natural gas. Part 2. Marine transportation. A bibliography with abstracts. Search period covered: 1964—May 1975.** Lehmann, E.J. (National Technical Information Service, Springfield, Va. (USA)). Jun 1975. 95p. NTIS $25.00.

Abstracts are presented of studies on all aspects of marine transportation of liquefied natural gas. This includes reports on forecasts, cargo tank design, terminal facilities, spills, safety aspects, special tanker design, and handling equipment. (Contains 44 abstracts). See also NTIS/PS-75/463, Natural Gas. Part 1. Supply, Demand, and Utilization.

25377 ASME guide for gas transmission and distribution piping systems: 1976. New York; American Society of Mechanical Engineers (1976). 391p.

The guide material presented includes information and some of the acceptable methods to assist the operator in complying with the Minimum Federal Safety Standards on materials, pipe design, design of pipeline components, welding of steel in pipelines, joining of materials other than by welding, general construction requirements for transmission lines and mains, customer meters and service, requirements for corrosion control, test requirements, uprating, operations, and maintenance. Federal Standard appendixes and guide appendixes are included. The Federal Rules and Regulations on reports of leaks and minimum federal safety standards and amendments to these regulations are given in full. (JSR)

25378 Double foot valve for cryogenic fluid containing tanks. Kohnen, K. (to Air Products and Chemicals, Inc.). US Patent 3,963,381. 15 Jun 1976. Filed date 21 May 1975. 6p.

An improvement in an apparatus is described that is suited for removing liquid (e.g., flammable) from a bulk container. The equipment is comprised of pumping equipment in the container, a fluid transmitting casing extending from an upper portion in the container to a lower portion and communicating with the pumping equipment, an inlet communicating with the pumping equipment, a fluid outlet at the upper part of the container communicating with the casing, a foot valve for sealing the inlet from the container when in a closed position and permitting the fluid flow from the container through the inlet to the casing when in the open position. The foot valve is provided with a means responsive to lifting movement of the pumping equipment for closing it and a sealing gland at the top of the casing accommodating movement of the pumping equipment for permitting opening and closing of the foot valve without venting the casing. The improvement comprises a "double foot valve" comprising an inner poppet carrying a sealing surface and extending across said inlet for sealing engagement when in a closed position, and an outer poppet carrying a sealing surface and extending across the inlet for sealing engagement when in a closed position, the outer poppet carrying the inner poppet for independent axial movement.

PROPERTIES

REFER ALSO TO CITATION(S) 25212, 25374

STORAGE

25379 (COM—75-10517) **Study of dynamic loads caused by liquid sloshing in LNG tanks. Volume I. Text and figures. Technical investigation report.** Olsen, H.A.; Hysing, T. (Det Norske Veritas, Oslo). Dec 1974. Contract MA-3-36282. 299p. NTIS $8.75.

The effects of fluid properties on scaling liquid sloshing pressures and forces were investigated. Sloshing pressures and forces were measured in both prismatic and spherical tanks for a range of fill depths, excitation amplitudes and frequencies. Loads on internal tank components, such as pump towers, were also determined for spherical tanks. (GRA)

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 25197, 25959, 25987

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

25380 Mineral profile of Wyoming's Green River Formation: oil shales sampled by Blacks Fork Core. Robb, W.A.; Smith, J.W. (Laramie Energy Research Center, WY). *Earth Sci. Bull.*; 9: No. 1, 1-7(Mar 1976).

Stratigraphic relationships of minerals and organic matter in the trona-bearing lower Wilkins Peak Member and the Tipton Shale Member of Wyoming's Green River Formation are presented as histogram plots with depth. Oil yields and x-ray diffraction peak heights of 17 minerals are presented for samples from an oil-shale core drilled near the depositional axis of the Green River Basin. The mineral and oil-yield profiles picture graphically a remarkable lacustrine sedimentary sequence involving the deposition of hydrogen-rich organic matter in oil shale and the development of sodium carbonate minerals. The emphatic difference in mineralogy between the Tipton Shale and the Wilkins Peak Members is evaluated. In addition, the major occurrence of the mineral nahcolite ($NaHCO_3$) heretofore noted only as a single trace in Wyoming's Green River Formation is reported.

SITE HYDROLOGY

25381 Nature of black water occurrence: northern Green River Basin. Dana, G.F.; Smith, W.W. (Laramie Energy Research Center, WY). *Earth Sci. Bull.*; 9: No. 1, 9-16(Mar 1976).

A unique black trona water occurs in oil shales of the Wilkins Peak Member of the Green River Formation in the northern part of the Green River Basin, Wyoming. The color of the water is caused by organic acids dissolved in sodium carbonate brine. From 1949 through 1972, 18 wells penetrated the aquifer. Recent drilling has extended the area five miles west, encompassing an estimated area of 20 additional square miles. Because the black water aquifer was of an unknown type, it was cored with a rubber-sleeved core barrel which recovered the core intact. Slow coring and careful measurements pinpointed the aquifer in the subsurface to within a 3-inch length. The aquifer is established as one or two smooth horizontal partings in oil shale rather than cavities created from secondary crystallization. The aquifer is pressurized by overburden rather than gas or hydrostatic pressure.

OIL PRODUCTION, RECOVERY, AND REFINING

IN SITU METHODS, TRUE AND MODIFIED

25382 (CONF-760342—4) **Current developments in oil shale research at the Laramie Energy Research Center.** Jacobson, I.A. Jr.; Burwell, E.L.; Harak, A.E.; Long, A.; Wise, R.L. (Energy Research and Development Administration, Laramie, Wyo. (USA). Laramie Energy Research Center). 1976. 14p. Dep. NTIS $3.50.

From Symposium on alternate fuel resources; Santa Maria, California, United States of America (USA) (25 Mar 1976).

Current oil shale research being conducted at the Laramie Energy Research Center is many faceted, and some of the recent developments in these areas are presented. Concurrent gasification

and retorting of oil shale where the effects of operating pressure and amounts of oxygen and water injection on quality and quantity of gas and oil produced is being studied. This work has resulted in off gas with heating values varying from 50 to 1,300 Btu/ft^3 and oil recovery of up to 80 vol percent of Fischer assay. The effects of retorting atmosphere, pressure, and external heating rate are being studied in a high pressure batch retort. Results from this work indicate that a nitrogen atmosphere decreases oil yield slightly while a hydrogen atmosphere increases the oil yield significantly. Large blocks of oil shale are being retorted in a 150-ton aboveground retort to study the abnormal heating rate of the interior of the blocks. This could be caused by an oxidation exotherm similar to that found in limited DTA studies. Some early results from the Rock Springs site 9 in-situ experiment are also presented. This is the fifth in-situ combustion experiment and is being performed in a 40-foot-thick oil shale bed having an average Fischer assay of 23 gallons per ton.

25383 In situ recovery processing. Decora, A.W.; Schrider, L.A. (Laramie Energy Research Center, WY). *Hydrocarbon Process.;* **55**: No. 5, 117-119(May 1976).

Research, development, and demonstration programs on the in-situ processing of oil shale, coal, and tar sands are discussed. Future plans are outlined. (JGB)

SURFACE METHODS

REFER ALSO TO CITATION(S) 25247, 25382

25384 Conditioning drum for use in hot water separation of bitumen from mined tar sands. Stuchberry, F.C. (to Shell Oil Co.). US Patent 3,968,572. 13 Jul 1976. Filed date 3 Apr 1975. 10p.

A rotating drum type muller is described for initial conditioning of mined tar sands by the hot water method for separation of bitumen from the sands in which ablation of mined tar sand lumps into pulp is effected through the addition of hot water, steam, and caustic. This conditioning drum is made up of a horizontally disposed cylindrical drum of a length to diameter ratio of about 1:1 or less, rotatable around its longitudinal axis and having axial openings at its inlet end for introduction of mined tar sand lumps, water and caustic and at its outlet end for rejection of oversize and discharge of mulled tar sands pulp. The axial opening at its outlet end is divided by a coaxial grate member, extending along the longitudinal axis of the drum, into an outer annular opening for discharge of tar sands pulp and an inner axial opening for rejection of oversize. The grate size is sufficient to allow ready passage of tar sands pulp into a discharge passageway defined by the outer annular opening while retaining the oversize. A plurality of downwardly projecting steam conduits affixed to a stationary steam header extend substantially over the length of the drum interior along the longitudinal axis of the drum, the conduits being perforated for injecting steam into the cylindrical drum.

REFINING

25385 (CONF-760342—3) **Diesel fuels from shale oil.** Cottingham, P.L. (Energy Research and Development Administration, Laramie, Wyo. (USA). Laramie Energy Research Center). 1976. 17p. Dep. NTIS $3.50.

From Symposium on alternate fuel resources; Santa Maria, California, United States of America (USA) (25 Mar 1976).

High-boiling shale oil produced from Rocky Mountain oil shale can be reduced in molecular weight by recycle thermal cracking and by coking. Selected research on the production of diesel fuels from shale oil is reviewed. Diesel fuels of good quality have been made from cracked shale oil by acid and caustic treating. Diesel oil made by this process performed acceptably in an in-service test for powering a railroad engine in a 750-hour test. Better quality diesel fuels were made by hydrogenation of a coker distillate. Even better quality diesel fuels, suitable also for use as high-quality distillate burner fuels, have been made by hydrocracking of a crude shale oil from underground in-situ retorting experiments.

25386 (CONF-760342—5) **Motor gasoline from shale oil.** Cottingham, P.L. (Energy Research and Development Administration, Laramie, Wyo. (USA). Laramie Energy Research Center). 1976. 13p. Dep. NTIS $3.50.

From Symposium on alternate fuel resources; Santa Maria, California, United States of America (USA) (25 Mar 1976).

Shale oil produced from oil shale of the Rocky Mountain region by many of the usual retorting processes consists mainly of high boiling compounds of nitrogen, sulfur, and oxygen; less than half of the oil consists of hydrocarbons. Selected research on the upgrading of shale oil is reviewed. Thermal cracking of the oil followed by acid and caustic treating of the gasoline fraction has produced stable gasolines with low to moderate octane numbers. Hydrogenating the raw crude oil has produced higher yields of stable gasolines, also with low to moderate octane numbers. The yields and octane numbers of the gasolines are dependent on the hydrogenation temperatures used. Low-octane hydrogenated gasoline has been catalytically reformed over platinum-containing catalyst to produce high-octane motor fuel.

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 25198, 25382

25387 Fischer assay: standard for the oil shale industry. Heistand, R.N. (Development Engineering, Inc., Rifle, CO). *Energy Sources;* **2**: No. 4, 397-405(1976).

The Fischer assay is used to measure the potential oil yield from oil shale. Although the automated modified Fischer assay has been the standard for the oil shale industry, the basic equipment design and procedure need improvement. Several improvements are discussed. The use of continuous control, proportional heating, permanent recording, and careful sample preparation and handling provide more uniform operation and more reliable data. However, for the Fischer assay to serve as the standard for the future oil shale industry, still more improvements will be needed.

WASTE RESEARCH AND MANAGEMENT

REFER ALSO TO CITATION(S) 26497

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 26668

FISSION FUELS

REFER ALSO TO CITATION(S) 25987

RESERVES

25388 (GJBX—20(76)) **Summary of the stratigraphy, sedimentology, and mineralogy of Pennsylvanian and permian rocks of Oklahoma in relation to uranium-resource potential.** Olmsted, R.W.; Hanson, R.E.; May, R.T.; Owens, R.T. (Oklahoma State Univ., Stillwater (USA)). 27 Feb 1976. Contract AT(05-1)-1641. 361p. Dep. NTIS $10.50.

Pennsylvanian-Permian strata in Oklahoma were deposited in environments which ranged from deep marine to alluvial fan. The former was most common in the Ouachita geosyncline during Early Pennsylvanian, but parts of the Anadarko basin were also relatively deep water during Middle and Late Pennsylvanian. Alluvial-fan deposits in Oklahoma are related primarily to the Amarillo-Wichita-Criner, Arbuckle, and Ouachita uplifts. As a result of erosion of the Wichita and Arbuckle areas during the Pennsylvanian-Permian, Precambrian and Cambrian felsic igneous rocks were exposed and became sources of significant quantities of feldspar in the sandstones and conglomerates, especially those on the flanks of the uplifts, and possibly sources of significant uranium concentrations in basinal waters. The Ouachita uplift, Sierra Grande-Apishapa uplift to the northwest, and possibly the Appalachian system also furnished feldspar to form the rather common subarkoses in the Upper Pennsylvanian-Permian. Feldspar is an apparent source of uranium which is present in the alluvial-fan deposits associated with the Wichita and Arbuckle uplifts, the Permian sandstones on oil-producing structures in southern Oklahoma, the lenticular sandstones on the Muenster-Waurika arch, and the tidal-flat sandstone-siltstones in western Oklahoma and possibly in north-central Oklahoma. Radioactive anomalies associated with Cherokee sandstones may be related to the Desmoinesian phosphatic shales, local depositional environments of deltaic complexes which influenced diagenetic conditions, and/or the pre-Pennsylvanian unconformity with respect to the radioactive Woodford Shale.

25389 (GJBX—21(76)) **Geology of the Fox Hills Formation (late Cretaceous) in the Williston Basin of North Dakota, with reference to uranium potential. Report of investigation No. 55.**

Cvancara, A.M. (North Dakota Geological Survey, Grand Forks (USA)). 1976. Contract AT(05-1)-1633. 18p. (GJO—1633-1). Dep. NTIS $3.50.

The Fox Hills Formation is a marine and brackish sequence of primarily medium and fine clastics within the Late Cretaceous Montana Group. In the Williston basin of North Dakota, four members (in ascending order) are recognized: Trail City, Timber Lake, Iron Lightning (with Bullhead and Colgate lithofacies), and Linton. The Fox Hills conformably overlies the Pierre Shale and conformably and disconformably underlies and interfingers with the Hell Creek Formation; it occurs in about the western two-thirds of the state. The geology of the Fox Hills Formation in North Dakota, and the stratigraphy of which is based on previous surface information and recent subsurface data, are summarized, and its potential for uranium is evaluated. (LK)

25390 (GJBX—22(76)) **Stratigraphy and environments of deposition of the Cretaceous Hell Creek Formation (reconnaissance) and the Paleocene Ludlow Formation (detailed), southwestern North Dakota. Report of investigations No. 56.** Moore, W.L. (North Dakota Geological Survey, Grand Forks (USA)). 1976. Contract AT(05-1)-1633. 43p. (GJO—1633-2). Dep. NTIS $4.00.

The Cretaceous Hell Creek and Paleocene Ludlow Formations of southwestern North Dakota, with the exception of the included lignite beds and minor amounts of concretions and nodules, are almost exclusively clastic sediments and sedimentary rocks. Massive clays, clays alternating with silts and sands, sandstones filling channels and other depressions, sheet sandstones, and lignites are the dominant sediment and rock types present. These sediments and sedimentary rocks were mostly deposited in a continental environment and were largely alluvial, lacustrine or paludal in origin; though marginal marine deposition, in part, is indicated by the occurrence of brackish water faunas in portions of the upper Ludlow Formation. With the possible exception of a persistent lignite near the base, persistent lignites are not present in the Hell Creek Formation. The Ludlow can be subdivided into several informal units, typically coal-bounded, which can be traced laterally over large areas. This informal subdivision permits isolation of stratigraphic units for the study of local environments of deposition. Channel and depression fill sandstones of the Ludlow Formation have a relatively low permeability and a high organic content at the surface and, for this reason, are considered poor prospective uranium host rocks. The lighter colored yellow winnowed sheet sandstones of the Ludlow are more permeable and relatively free of organic matter. They are considered as possible host rocks for uranium occurring in association with an oxidation/reduction interface at shallow depths. The uranium potential is enhanced where the latter sandstones occur along paleodivides which have been overlain by the Oligocene White River Formation, or in local areas where the latter formation is still preserved. Light yellow winnowed sheet sandstones are rare in the Hell Creek Formation, and the chances for uranium prospects in this interval seem correspondingly reduced.

25391 (GJO—100(76)) **Statistical data of the uranium industry.** (Energy Research and Development Administration, Grand Junction, Colo. (USA). Grand Junction Office). 1 Jan 1976. 90p. Dep. NTIS $5.00.

Historical facts and figures of the uranium industry through 1975 are compiled. Areas covered are ore and concentrate purchases; uranium resources; distribution of $10, $15, and $30 reserves; drilling statistics; uranium exploration expenditures; land holdings for uranium mining and exploration; employment; commercial U_3O_8 sales and requirements; and processing mills. (LK)

25392 (INIS-mf—3071) **Bibliography: Uranium resources with special reference to Australia.** (Institution of Engineers, Sydney (Australia)). 1975. 2p. INIS.

The bibliography is divided into two sections: Part A -Uranium resources (general) (29 refs.) and Part B -Australian Uranium resources (9 refs.).

EXPLORATION

25393 (DP—1432) **SRL-NURE hydrogeochemical data management system.** Maddox, J.H.; Wren, H.F.; Honeck, H.C.; Tharin, C.R.; Howard, M.D. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jul 1976. Contract AT(07-2)-1. 48p. Dep. NTIS $4.50.

A data management system was developed to store and retrieve all physical, chemical, and geological data collected for the NURE Hydrogeochemical Reconnaissance program by the Savannah River Laboratory (SRL). In 1975, SRL accepted responsibility for hydrogeochemical reconnaissance of twenty-five states in the eastern United States as part of the National Uranium Resource Evaluation (NURE) program to identify areas favorable for uranium exploration. The SRL-NURE hydrogeochemical data management system is written in FORTRAN IV for an IBM System 360/195 computer. The system is designed to accommodate the changes in the types of data collected about a sampling site and for the different numbers of samples taken at the sites. The data are accepted as they become available and are combined with relevant data already in the system.

25394 (INIS-mf—2066) **Geological exploration of uranium ores at Burgos' basin.** Cabrera Valdez, M.E. (Instituto Politecnico Nacional, Mexico City. Escuela Superior de Ingenieria y Arquitectura). 1975. 60p. (In Spanish). INIS.

Thesis.

The outcrop sediments of the Burgos river basin cover the complete Cenozoic sequence from the Pallaeocene to recent date, and are arranged in the form of parallel strips with a regional dip towards the east, in which direction the sediments become steadily younger. Generally speaking they correspond to a regressive process the lithology of which is an alternation of shales, sandstones, tuffaceous material and conglomerates. The explorations and evaluations of sedimentary uranium deposits so far carried out in the north-east of Mexico show close relationships between the mineralization and the sedimentary processes of the enclosing rock. Analysis of the sedimentary-type uranium ore bodies in Mexico indicates characteristics very similar to those found in the deposits of the same type which were first studied and described in southern Texas and were used as a standard for the first exploratory studies. The uranium ore in the State of Texas is found in sands belonging mainly to the Jackson group of the Eocene and, to a lesser extent, the Catahoula formation of Miocene-Oligocene age. In the Burgos basin the existence of uranium deposits in the non-marine Frio formation of Oligocene age, with geological characteristics similar to the Texan deposits, has been demonstrated. This comparative analysis suggests very good prospects for uranium exploration in the region; it is recommended that priority be given to intensive study of the sediments of the non-marine member of the Frio formation, and the Jackson and Catahoula formations.

25395 (K-TL—524(Pt.1)) **National uranium resource evaluation program. Hydrogeochemical and stream sediment survey in Central United States. Fourth quarter FY 1975, April 1, 1975—June 30, 1975.** Joyner, J.D.; Marshall, G.L. (comps.). (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 2 Sep 1975. Contract W-7405-eng-26. 15p. Dep. NTIS $3.50.

The National Uranium Resource Evaluation (NURE) Program will be administered by the Grand Junction Office of the U.S. Energy Research and Development Administration (ERDA). One part of this program consists of a hydrogeochemical and stream sediment survey of the entire United States. Union Carbide Corporation, Nuclear Division (UCC-ND) will conduct this survey over approximately one million square miles of the Central U.S., which includes the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, Texas, South Dakota, and Wisconsin. Lawrence Livermore Laboratory (LLL), Los Alamos Scientific Laboratory (LASL), and Savannah River Laboratory (SRL) have accepted similar responsibilities for coverage of the remaining states. The objective of UCC-ND is to carry out an innovative and cost effective hydrogeochemical and stream sediment survey program, in order to provide high quality, meaningful data which can be used to identify areas favorable for detailed uranium prospecting. A new organization called the Uranium Resource Evaluation Project has been formed within the Oak Ridge Gaseous Diffusion Plant operated by UCC-ND. A Project Manager, with a team of 10 to 12 people, will coordinate activities in analytical chemistry, geology and geochemistry, planning and statistics, field sampling, data management and information systems, and quality control.

25396 (K-TL—524(Pt.2)) **National uranium resource evaluation program. Hydrogeochemical and stream sediment survey in Central United States. First quarter FY 1976, July 1, 1975—September 30, 1975.** Arendt, J.W. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 26 Nov 1975. Contract W-7405-eng-26. 45p. Dep. NTIS $4.00.

Work continued during the quarter to determine the analytical and sampling methodology to be used by UCC-ND in the Hydrogeochemical and Stream Sediment Survey. A sampling training session at Denver, Colorado was coordinated with the U.S. Geological Survey for all participants in this project. Also, a sampling trip was made to Texas in cooperation with Savannah River Laboratory personnel. Several industry contacts were made to obtain their ideas, particularly those regarding desired data which could be incorporated into the NURE Program. UCC-ND is continuing to receive excellent cooperation from the other Federal agencies, in particular USGS and the Environmental Protection Agency. This is very important toward minimizing duplication of

effort. Work continued on the development of a quality control plan which will provide the proper quality level and ensure that the final report will be reliably useful to industry. Procedures are being developed for preparing solution batches and for screening and blending sediment batches. A summary of UCC-ND activities during the quarter is presented. Also included is a listing of plans for the second quarter. Future quarterly reports will show a comparison of accomplishments versus projected plans.

25397 (PB—241576) **Physical properties of uranium host rocks and experimental drilling at Long Park, Montrose County, Colorado. Final report.** Manger, G.E.; Gates, G.L.; Cadigan, R.A. (Geological Survey, Denver, Colo. (USA)). 1975. 57p. (USGS-GD—75/005). NTIS $4.25.

See also PB—241577.

A core-drilling study in uranium host rocks of the Jurassic Morrison Formation in southwestern Colorado attempted to obtain samples of host rock in its natural state. Three holes were drilled, holes and core were logged for radioactivity and electrical properties. Samples were analyzed for physical and chemical properties. Drilling results suggest that drilling with dried air yields core with least contamination at least cost. Drilling with oil results in maximum core recovery but also maximum cost and significant core contamination. Drilling with water results in contamination and loss of original pore water. A factor group of variables present are: Those positively related to uranium mineralization are poor sorting, percent by weight clay, percent of pore space containing water; negatively related variables are median grain size (mm), electrical resistivity, permeability. Optimum depth to locate ore seems to be at the top of the pore water capillary circulation zone, below the dehydrated no-capillary-circulation zone. (GRA)

MINING

REFER ALSO TO CITATION(S) 25913

FEED PROCESSING

REFER ALSO TO CITATION(S) 25453, 25454, 25455, 25494, 26204

25398 (INIS-mf—2065) **Initiation in the study of uranium recovery from the phosphoric acid.** Anchondo Adalid, J.M. (Universidad Veracruzana, Orizaba (Mexico). Facultad de Ciencias Quimicas). 1974. 80p. (In Spanish). INIS.

Thesis.

The loss of considerable amounts of uranium in the Mexican phosphoric acid industry makes it important to study economic methods of recovery; the studies can serve as a basis for the construction and operation of a pilot plant as a normal preliminary to larger-scale projects. Routine experimental techniques for solvent extraction were employed. Extraction efficiencies of the order of 90-95% were obtained using 0.09-0.18M solutions of a mixture of phosphoric octyl esters applied to 4 and 6M solutions of phosphoric acid (reagent grade) containing uranium in concentrations of 0.05-0.50g of U_3O_8 per litre of acid. The conclusion was reached that phosphoric octyl esters can be used for recovering uranium in satisfactory quantities from phosphoric acid solutions by means of solvent extraction, and that the uranium can be separated from the solvent by the established procedures.

ENRICHMENT

25399 Principles and techniques of uranium enrichment. Frejacques, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Div. de Chimie); Mezin, Michel (CEA, 75 - Paris (France). Dept. des Applications Industrielles de la Separation Isotopique). *Rev. Gen. Nucl.;* **1**: No. 4, 256-264(Sep 1975). (In French).

The main separation processes already used industrially or likely to be used before the end of century (gas diffusion, ultracentrifugation, laser, the nozzle process, a process developed in South Africa) are presented. Some data on the costs of the enrichment are clarified. The main characteristics of the enrichment market in which the Eurodif plant is called upon, on the expiration of five years, to take a foremost place are reported.

25400 Concentration of uranium-235 in mixtures with uranium-238 using ion exchange resins. Seko, M.; Kakihana, H. US Patent 3,953,569. 27 Apr 1976. Priority date 22 Jul 1971, Japan. 26p.

A method is described for simultaneously obtaining separate enriched fractions of ^{235}U and ^{238}U from isotopic mixtures of these with the use of an ion exchange column by passing a liquid body containing the isotopic mixture through the column. The uranium as it is passed through the column is present as a U(IV) coordination compound with a ligand at different valent states and is followed by an eluant and forms a band which travels through the column, the front and rear portions of which are respectively enriched in one of the isotopes and depleted in the other. 16 claims, no drawings.

GASEOUS DIFFUSION

REFER ALSO TO CITATION(S) 25479

25401 Threshold of the nineteen-eighties... Eurodif. Besse, G.; Leduc, C. (Societe EURODIF, 92 - Bagneux (France)); Ergalant, J. (Societe de Construction d'une Usine de Separation Isotopique (USSI), 92 - Le Plessis-Robinson (France)). *Rev. Gen. Nucl.;* **1**: No. 4, 268-279(Sep 1975). (In French).

Eurodif will be the first European plant for the enrichment of uranium by gaseous diffusion. After having presented the project and the different agreements signed for its finalization, the authors give a description of the plant for which the construction work has started on the Tricastin site, and for which the supply of the first enrichment services is foreseen from and after 1979. A certain number of particulars are given concerning the techniques which will be applied at level of the diffusion cascade (diffuser and barriers, compressor, heat exchanger) and also on the electric power supply of the plant and its construction cost. The position of Eurodif on the market of uranium enrichment (an essential position on account of the very rapid development of requirements) is defined.

25402 Some technical aspects of the application of IAEA safeguards to enrichment facilities. Vol. I. Babaev, N.S.; Sazykin, A.A.; Miller, O.A.; Verbin, Yu.V.; Abbakumov, E.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). pp 609-616 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976). (In Russian)

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

Technical problems concerning the application of IAEA safeguards to uranium-enrichment facilities are considered. It is shown that effective safeguards can be achieved if facilities with centrifuges have a "closed" zone. It is concluded that for safeguards purposes it is advisable to consider the actual amount of ^{235}U in the "closed" zone.

25403 Physical protection of special nuclear material at United States Nuclear Regulatory Commission licensed fixed sites. Vol. I. Bean, C.H. (Argonne National Lab., Ill. (USA)); Norderhaug, L.R. (Nuclear Regulatory Commission, Washington, D.C. (USA)). pp 233-247 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

Facilities such as fixed sites for reprocessing or fabricating certain quantities of special nuclear material are required by the Nuclear Regulatory Commission (NRC) to provide physical protection against theft and sabotage. Similar measures are required at nuclear power reactors to protect against sabotage that endangers the health and safety of the public. Physical-protection requirements are based on a "defense-in-depth" concept of increased protection by increasing levels of physical restraint, access control, intrusion-detection capability, and response capability depending on the particular material or equipment being protected. The NRC issues voluntary guides identifying acceptable methods for implementing physical protection regulations. A hypothetical model for the physical-protection of a mixed-oxide fuel-fabrication plant was developed from information obtained from NRC regulatory guides. The model provides for an outer fence-type barrier and inner barriers of masonry construction. Access is controlled at each barrier and individuals and packages are searched. Microwave and vibration-sensitive sensors detect intruders approaching and crossing the outer barrier. Ultrasonic or microwave sensors detect intruders in vital areas and material-access areas. Emergency exits are equipped with balanced magnetic switch alarms. Closed-circuit-television cameras provide continuous surveillance of lighted isolation zones and working areas. A hardened central alarm station and a second alarm station both receive all alarms and both have a capability for initiating response action that may include calling by either radio or telephone for assistance from local law-enforcement authorities.

25404 Instrumented safeguards at nuclear power stations. Vol. I. Boedege, R. (Vereinigte Elektrizitaetswerke Westfalen A.G. (VEW), Dortmund (F.R. Germany)); Braatz, U. (Vereinigung Deutscher Elektrizitaetswerke e.V. (VDEW), Frankfurt am Main (F.R. Germany)); Heger, H. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Biblis (F.R. Germany). Betriebsverwaltung). pp 165-173 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

In implementing the Verification Agreement between IAEA and the seven Non-Weapon States of the European Community, several ways and means exist. One of them, based purely on item counting, was worked out and is presented here. After stating the peculiarities of LWR fuel, the advantages of item counting in LWRs and the requirements on seals and cameras as a means of safeguarding are discussed. The qualities of the available cap seals and the requirements on camera systems guide the proposal of a supervision method, where the individual steps of handling and supervising the fuel assemblies are described. Special consideration is given to the procedures for the transitions from mass to item accountancy and vice versa. Item counting and item accountancy are shown to suffice in ensuring that no special nuclear material is diverted from the closed part of the fuel cycle. The individual methods described appear to constitute basic elements in a simple safeguards system for LWR power plants.

25405 Continuous inventory in special nuclear materials (SNM) storage facilities. Vol. I. Chambers, W.H. (Los Alamos Scientific Lab., N.Mex. (USA)). pp 281-285 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

As the quantity of special nuclear materials (SNM) in temporary or permanent storage grows, so does the economic burden of adequately protecting and controlling those materials. Frequent physical inventories may also result in undesirable radiation exposures to personnel. Consequently, we have investigated instrumentation and data-processing techniques which provide inexpensive verification of material in storage. Transfers of SNM into the storage area are accompanied by an automated verification of the container identity, weight, and the radiation signature of the contents. This information is computer-processed and stored for comparison at subsequent transfers and also provides the data base for record purposes. Physical movement of containers across the boundary of the storage area is at present accomplished by operating personnel in order to minimize expensive modifications to existing storage facilities. Personnel entering and leaving the storage area are uniquely identified and also pass through portal monitors capable of detecting small quantities of SNM. Once material is placed on the storage shelves, simple, low-cost container tagging and radiation sensors are activated. A portion of the prescribed gamma signature, obtained by duplicate shelf monitors during the transfer verification, is thus continuously checked against the stored identification data. Radiation detector design is severely constrained by the need to discriminate individual signatures in a high background area and the need for low unit costs. In operation any unauthorized change in signal is analysed along with auxiliary data from surveillance sensors to activate the appropriate alarms.

25406 COMSAC: Computerized measurements for safeguards and accountability. Vol. I. Chanda, R.N.; Lawless, J.L.; Harlan, R.A.; Minges, G.P. (Rockwell International Rocky Flats Plant, Golden, Colorado, US). pp 325-332 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

A computerized radiometric non-destructive assay system is described in which a single minicomputer controls three separate counters. Details of each counter design and operation are given. The computer, its peripherals, and mode of system operation are described together with the advantages of computerizing NDA counting systems. Future plans to computerize two additional counting systems plus real-time accountability are given.

25407 Material surveillance and verification programme at a uranium enriching plant. Vol. I. DeVito, V.J. (Goodyear Atomic Corp., Piketon, Ohio (USA)). pp 461-470 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

A licence for a nuclear facility in the United States of America is approved only after a licencee demonstrates by procedure or practice that an adequate material control system exists. A licence can specify acceptable material control practices. Therefore, processors in the United States receiving uranium hexafluoride (UF_6) from a United States Government-owned enriching plant can accept shipper's values for nuclear material accounting purposes if: (1) there is surveillance during withdrawal of the UF_6; (2) an independent sample is obtained; and (3) certain measurement verification is subsequently performed by the receiver or the receiver's agent. Because of the high equipment and operating costs, essentially all UF_6 processors have adopted a surveillance and verification programme. A resident observer is employed to perform surveillance, obtain samples, and make the shipping cylinders tamper-safe. Samples are analysed by the receiver or by an independent laboratory. The observer determines by surveillance that withdrawals, or transfers of material, weighings, and sampling are accomplished in accordance with accepted procedures. Surveillance of the withdrawals includes observing the transfer of UF_6 from the enriching plant cylinder to the shipping cylinder(s) and the withdrawal of samples. In addition, it includes observing the weighing of all cylinders associated with a sample lot of UF_6. Following the surveillance of withdrawals, weighings, and sampling, the cylinders are made tamper-safe by the application of tamper-indicating devices. Statistics for the verification programme have shown shipper and receiver measurements to be within the limits acceptable for adequate material control.

25408 Nuclear materials accounting at Springfields. Vol. I. Dodsworth, N.; Burton, M.L. (British Nuclear Fuels Ltd., Risley). pp 489-497 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

The design of a computerized system for Nuclear Materials Accounting, for use at the Springfields Works of British Nuclear Fuels Limited (BNFL), is described. Problems arising in accounting for nuclear materials are outlined. The development of a batch identification system as an aid in identifying the flow of material through a series of processes is briefly discussed. The system uses a DATA 100 key-batch system at Springfields for data entry and editing, but the main files are held on an ICL 4/72 central computer at Risley and are updated from the key-batch terminals at regular intervals. Some information such as stock inventories are transmitted back from the main computer to the terminal where it is therefore always on-line. The system is designed to use data for a varitey of functions producing daily and weekly information for production management use and producing monthly safeguards returns, periodic financial returns and others as required. There are essentially two types of file in use in the system, transaction files which are used to meet day to day requirements and other files which are updated only at specified times to contain information relating to a fixed period of time. These files are used to produce reports relating to the chosen period.

25409 Statistical methods for the planning of inspections. Vol. I. Hough, C.G.; Beetle, T.M. (International Atomic Energy Agency, Vienna (Austria)). pp 561-579 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

Inspection plans are designed to detect diversions of M kilograms of nuclear material with a high degree of confidence. Attribute sample plans were first developed and applied at a zero-energy fast reactor in the United Kingdom in co-operation with the Agency. Battelle-Northwest in the United States of America proposed a variables sample plan based on decision theory. The Karlsruhe Research Center in the Federal Republic of Germany developed the strategic points concept and sample plans based on game theory considerations. All these approaches were combined into a common approach which is summarized in this report.

25410 Case studies on the statistical analysis of safeguards data. Vol. I. Jaech, J.L. (Exxon Nuclear Co., Richland, Wash. (USA)). pp 545-558 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

It is important to characterize measurement errors, and information on measurement error parameters can come from many different sources. The statistical techniques useful for estimation and hypothesis testing in some situations are not well known. By means of case studies, attention is called to some of these techniques. The first case study involves shipper and receiver mea-

surements of per cent uranium in the transfer of low enriched UF_6 cylinders. In the second study, non-destructive assay measurements on some barrels of plutonium wastes are considered. Finally, a method for obtaining overall estimates of measurement parameters when data arise from several experiments is presented.

25411 Non-destructive assay technology nd in-plant dynamic materials control - "DYMAC". Vol. I. Keepin, G.R.; Maraman, W.J. (Los Alamos Scientific Lab., N.Mex. (USA)). pp 305-320 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

An advanced system of in-plant materials control known as DYMAC (Dynamic Materials Control) is being developed for the United States Energy Research and Development Administration by the Los Alamos Scientific Laboratory. This major safeguards research and development effort merges the latest non-destructive assay instrumentation and computer technology, with the clear objective of demonstrating a workable, cost-effective system of stringent, "real-time" control of nuclear materials in a modern plutonium processing facility. Emphasis is placed on developing practical solutions to generic problems of materials measurement and control, so that resulting safeguards techniques and instrumentation will have widespread applicability throughout the nuclear community.

25412 Nuclear material accountancy and control at the A-1 Bohunice Nuclear Power Plant. Vol. I. Klik, F.; Lukavsky, J. (Ceskoslovenska Komise pro Atomovou Energii, Prague); Kmosena, J.; Valovic, J. (Vyskumny Ustav Energeticky, Jaslovske Bohunice (Czechoslovakia)). pp 175-181 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

In this report, the nuclear material accountancy and control system as applied at the A-1 nuclear power plant at Jaslovske Bohunice, and the developmental work being carried out for improving this system, are described. From the aspect of nuclear material accountancy and control, the A-1 nuclear power plant is noted for some peculiarities as compared with the other types of nuclear power plants. The power plant is divided into two material balance areas (this being necessary with respect to assembling fuel elements inside the power plant), nuclear material flow inside the power station is rather complicated, and the visual identification of irradiated fuel is difficult. As far as the latter is concerned, developmental work is being carried out which may serve for unique fuel identification on the basis of gamma-spectra measurements of the spent fuel assemblies. The results obtained are evaluated, and plans for future activity to improve the nuclear material accountancy and control at the A-1 nuclear power station are described.

25413 Computer system for accounting and control of nuclear material. Vol. I. Onnen, S. (Kernforschungszentrum Karlsruhe (F.R. Germany)). pp 333-339 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

A system of data processing and accounting for industrial plants is being developed for nuclear material safeguards in the field of peaceful application of nuclear energy. A modular highly flexible software system has been worked out which is generally applicable with slight modification, taking into account the differences in industrial plants. The model of the fabrication plant is based on a structure of material balance areas (MBA). The computer system is described and contains the following programs: (1) system-generating program; (2) data-collection program; (3) information program; and (4) the special program. The system allows one to obtain rapid and complete information about the fissile material flow, MUF per MBA or per project, the shipper-receiver difference, etc. First an off-line system will be developed by the end of 1975 in the nuclear fuel element plant Nukem at Hanau in the Federal Republic of Germany.

25414 Practical problems in the verification of a family of inventory items. Vol. I. Rota, A.; van der Stricht, E.; Stanners, W. (Directorate of Euratom Safeguards, Luxembourg). pp 443-458 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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This paper deals with the problem of checking medium-size families of items of similar specification during inventory verifications. An example of quantitative analysis using the signed rank test is given. The hypotheses commonly accepted in the statistical tests performed are extensively discussed. The difficulties met in practice which limit the application of the theory are pointed out and the solution adopted in the case considered is illustrated.

25415 Application of probability methods for safeguards purposes. Vol. I. Rumyantsev, A.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). pp 535-542 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976). (In Russian)

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The authors consider possible ways of applying probability methods to solve problems involved in accounting for nuclear materials. The increase in the flow of nuclear materials subject to IAEA safeguards makes it necessary to increase the accuracy of determination of the actual quantities of nuclear materials at all stages of their processing and use. It is proposed that the IAEA's automated system of accounting for nuclear materials, based on accounting information for each material balance zone and the results of random experimental checks performed by IAEA inspectors, be supplemented with mathematical models of the flow of nuclear materials in each balance zone based on the data supplied for each facility in the balance zone when it was placed under safeguards. The statistical error in determining the material balance and the material unaccounted for can be considerably reduced in this way even if the experimental control methods are retained.

25416 Procedures used for the accountancy of uranium-235 in the fabrication of highly enriched uranium fuels. Vol. I. Sinclair, V.M.; Adam, W.B. (UKAEA Reactor Group, Dounreay. Dounreay Experimental Reactor Establishment). pp 499-514 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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Accountancy for the highly enriched uranium (75-93% U-235) in the fast reactor and material test reactor fuel-element manufacturing processes in the UKAEA plants at Dounreay, is described. It is based on the measurement of input - cast uranium rod and output - finished fuel elements, residues, wastes plus samples. The selection of key measurement points is described along with procedures for measurement and sampling. Data on the precision of measurements and sampling are given along with details of the analytical methods.

25417 Safeguarding nuclear material at a nuclear power station with a water moderated and cooled reactor. Vol. I. Skvortsov, S.A.; Miller, O.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii); Ovchinnikov, F.Ya.; Golubev, L.I.; Konoplev, A.P.; Kulakov, G.A. (Novovoronezhskaya Atomnaya Ehlektrostantsiya, USSR). pp 187-195 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976). (In Russian)

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On the basis of research carried out under contracts Nos 577 and 994 with the Agency the authors recommend safeguards procedures and methods of applying accounting, containment and surveillance techniques at a nuclear power station with a water moderated and cooled reactor. A method for inspectors to deduce the amount of nuclear material present at a power station is proposed. It is shown that the actual amount of nuclear material at a nuclear power station of this type can be determined with an accuracy of +-5% and a reliability of 0.95.

25418 Verification of plutonium inventories. Vol. I. Walker, A.C. (Energy Research and Development Administration, Richland, USA); Stewart, K.B.; Schneider, R.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). pp 517-531 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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Inspection experience and procedures in the verification inventory quantities of plutonium at Hanford are described. The statistical basis is presented from which sampling plans are determined specific to the quantities, subject to verification. Non-destructive assay (NDA) instrumentation is described which is

used to provide verification measurements on plutonium oxide and metal-stored materials. Typical data are shown and the results evaluated. The practical problems encountered in inspector verification by NDA means are addressed regarding the constraints encountered and solutions attained. Future work is outlined in the context of improvements desired in order to refine verification measurements of plutonium inventory quantities.

25419 Experience in nuclear materials accountancy, including the use of computers, in UKAEA. Vol. I. Anderson, A.R.; Adamson, A.S.; Good, P.T.; Terrey, D.R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). pp 341-351 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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The UKAEA have operated systems of nuclear materials accountancy in research and development establishments handling large quantities of material for over 20 years. In the course of that time changing requirements for nuclear materials control and increasing quantities of materials have required that accountancy systems be modified and altered to improve either the fundamental system or manpower utilization. The same accountancy principles are applied throughout the Authority but procedures at the different establishments vary according to the nature of their specific requirements; there is much in the cumulative experience of the UKAEA which could prove of value to other organizations concerned with nuclear materials accountancy or safeguards. This paper reviews the present accountancy system in the UKAEA and summarizes its advantages. Details are given of specific experience and solutions which have been found to overcome difficulties or to strengthen previous weak points. Areas discussed include the use of measurements, the establishment of measurement points (which is relevant to the designation of MBAs), the importance of regular physical stock-taking, and the benefits stemming from the existence of a separate accountancy section independent of operational management at large establishments. Some experience of a dual system of accountancy and criticality control is reported, and the present status of computerization of nuclear material accounts is summarized. Important aspects of the relationship between management systems of accountancy and safeguards' requirements are discussed briefly.

25420 Internal accounting system for feed materials in the plutonium fuel fabrication complex at Cadarache. Arnal, T.; Guillet, H. (CEA Centre d'Etudes Nucleaires de Cadarache. Vol. I, 13 - Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). pp 471-479 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976). (In French)

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The internal accounting system of the Fabrication and Radiometallurgical Inspection Service (SFER) is basically designed to meet national and international requirements for nuclear materials accountancy as applied to feed materials. The authors discuss the principles underlying this accounting system for the case of the Plutonium Fuel Assembly Fabrication Complex at Cadarache. The sphere of application of the system covers more than 200 work stations and approximately 100 different materials. Some 20000 movements of feed materials per year represent transfers of a cumulative mass much greater than one ton of fissile material. A data processing system has therefore become essential in order to ensure the rapid and reliable acquisition of accounting data relating to these movements. The authors describe the system (definition of stations and material codes, description of supporting facilities used) and discuss the mode of acquisition with particular reference to relative speed of action. In conclusion, the authors indicate that the system offers interesting possibilities, in addition to its original purpose, in the following areas: Preparation of material balances; compliance with safety regulations to avert the risk of criticality; discouragement of possible diversion.

25421 Risk classification for nuclear facilities in connection with the illegal use of nuclear materials. Vol. I. Bahm, W.; Naegele, G.; Sellinschegg, D. (Kernforschungszentrum Karlsruhe (F.R. Germany)). pp 19-26 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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It is shown, and illustrated by an example, that specific conditions at a nuclear facility to a large extent determine the probability of a successful illegal attack against that facility. Therefore, a categorization of nuclear materials according to the associated hazards alone, as practised currently, does not appear to be sufficient for the establishment of a balanced national physical protection system. In this paper a possible way of categorizing nuclear facilities according to the associated risks, determined as objectively as possible, is discussed. It is felt that initially the analysis should be restricted to the determination of the conditional risks, associated with illegal acquisition and use of radioactive materials by a postulated hostile or similar group.

25422 Computerized information system for inventory-taking and verification at a nuclear fuel fabrication plant with closed production lines. Vol. I. Bahm, W.; Brueckner, C.; Hartmann, G. (Kernforschungszentrum Karlsruhe (F.R. Germany)). pp 365-376 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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By means of a model the use of electronic data processing is studied for preparing inventory listings and for inventory verification in a fabrication plant for Pu-U mixed-oxide fuel pins. It is postulated that interruptions in operation should be avoided as much as possible. Closed-Line production is assumed so that access to nuclear material calls for special withdrawal via locks. The production line is subdivided into sections with measuring points placed in between to record the nuclear material flow. The measured results are fed to a central data acquisition and reporting system capable of calculating on-line from these results the book inventories present in the individual sections. Inventory-taking and verification are carried out simultaneously in the sections of the production line using the EDP system. The production is not interrupted for this purpose. The production stream is tagged prior to reaching a section to be measured and is subsequently measured when entering the respective section until the tag has reached the end of the section. The measurement can be verified by inspectors. Movements of nuclear materials in and from other plant areas such as the storage area are likewise fed into the central data processing system so that inventory lists can be recalled at any moment. By this means the inventory can be taken quickly and at any time. The inventory is verified in the conventional way.

25423 Italian experience with the existing safeguards systems. Vol. I. Bardone, G. (Technological Research Dept., CNEN, Casaccia, Italy); Pozzi, F. (Comitato Nazionale per l'Energia Nucleare, Saluggia (Italy). Programma Eurex); Venchiarutti, R.; Zifferero, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)); Zaffiro, B. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). pp 97-112 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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The paper surveys the experience acquired in safeguards through the implementation of the Rome Treaty and the Italy-USA Bilateral Agreement and through compliance with the Italian legislation on the peaceful uses of nuclear energy. The research and development activities carried out in co-operation with IAEA and the European Community under the ESARDA and special research agreements and contracts are illustrated. Safeguards systems as applied to the various stages of the fuel cycle, particularly during fuel fabrication, power generation and fuel reprocessing, are reviewed in the light of the current trends resulting from the requirements envisaged for the application of safeguards called for in the Non-Proliferation-Treaty. The review covers the problems encountered to date with verification of the consistency of experimental measurements, destructive and non-destructive test techniques, the existing surveillance and containment systems and the provisions for the physical protection of fissile material.

25424 Conceptual design of a system for nuclear material control in a research centre according to the IAEA safeguards requirements. Vol. I. Bueker, H.; Kotte, U.; Stein, G. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). pp 137-154 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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In comparison with other facilities handling nuclear material, a nuclear research centre is characterized by a wider spectrum of operations. This requires a number of installations within the centre such as research reactors, critical assemblies, research institutes and central departments, operating, in general, independently of each other. Nuclear material is stored and processed in small quantities and in different chemical and physical configurations within prescribed license areas. The conceptual design of a

new system for nuclear material control in a research centre has to consider the operator's and IAEA's safeguards requirements. Using the example of the Juelich Nuclear Research Centre in the Federal Republic of Germany, these requirements are being examined in conjunction with the specified peculiarities of a nuclear research centre. Following this, a division of the research centre into material balance areas and key measurement points is being proposed, based on the existing facilities and licence areas. The essential characteristic of the concept is a far-reaching displayability of the inventory and flow of nuclear material. The availability of information is based on differentiated material accountancy in conjunction with adequate measurement of nuclear material data. For data processing and generation of data, a computerized record and report system is to be provided as well as a central measurement system.

25425 Euratom experience of verification methods in fuel fabrication facilities. Vol. I. Busca, G.; Love, B.; van der Stricht, E. (Directorate of Euratom Safeguards, Luxembourg). pp 409-418 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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For the past six years within Euratom certain large plants for the preparation and fabrication of nuclear fuels containing plutnoium and highly enriched uranium have been subject to a system of objective safeguards measures, usually referred to as the reinforced inspection scheme. This system is based primarily on the physical measurement of all or some of the input and output flows and on the periodic determination of the nuclear material inventory within the plant. Descriptions are given of the organizational and communication procedures, the sampling and measurement procedures used for flow and for inventory assessment, and of the evolution of these procedures in the light of the experience gained.

25426 Features of the Danish system of nuclear material control in compliance with IAEA-NPT safeguards requirements. Vol. I. Frederiksen, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). pp 83-95 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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The NPT safeguards agreement between Denmark and the IAEA entered into force on 1 March, 1972. The Danish system of nuclear material control is established in compliance with the Non-Proliferation Treaty and the safeguards agreement. In setting up the Danish system emphasis was placed on features that would reduce the workload of the operators as far as possible. The paper deals with the Danish solutions to specific problems within each of the main areas of nuclear material control.

25427 General assessment of the utilization of the plutonium employed in the fabrication of fuel elements for Rapsodie (24 MW(th)). Vol. I. Guillet, H.; Arnal, T. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). pp 481-488 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976). (In French)

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The fast reactor Rapsodie operated at its initially rated power of 24 MW(th) from March 1967 to October 1969. It is therefore possible to provide a satisfactory characterization of individual features relating to that period of operation, especially as regards the plutonium used by the Cadarache fuel element fabrication group responsible for supplying the reactor. The waste produced during fabrication and in the course of the developmental studies was reprocessed at the chemical purification laboratory of this group. It was not until March 1975 that it became possible to make a virtually definitive overall assessment of this particular line of fabrication, i.e. a stage of immobilization whose components were sufficiently well known as far as masses of plutonium were concerned. After describing the various physical installations involved in this operation and the method of accounting for fissionable materials, the paper gives the characteristics of the plutonium used (around 400 kg) and presents an overall assessment of the fabrication operation, which covers the conventional headings of inputs, outputs, immobilized material, material unaccounted for, etc. A special chapter is devoted to specifying losses normally broken down in terms of liquid waste, solid waste etc. The authors also develop the idea of an inventory balance originating with imprecisions of determination, which amount to around 0.7% of the fissionable materials employed.

25428 Accounting and safeguards system for nuclear materials at the Rossendorf Central Nuclear Research Institute (Dresden). Vol. I. Heidel, S.; Kampf, T. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). pp 155-163 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976). (In Russian)

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The accounting and safeguards system for nuclear materials used at the Rossendorf Central Nuclear Research Institute is based on national directives and decrees. The adaptation of the system to the Safeguards Agreement with the Agency, in connection with the accession of the German Democratic Republic to the Treaty on the Non-Proliferation of Nuclear Weapons, has merely required some minor amendments: at the same time, however, it has made necessary extensive preliminary work for the purpose of devising the clearest possible and non-time-consuming method of recording data. Experience already gained indicates that the safeguards system as developed fulfils its purpose. The overall labour requirement is about 0.5 man-years. Work is being done to improve the system further by cutting down the time expended. Besides giving a general description of the system, the authors discuss the data forms used in operating it.

25429 Advanced physical protection systems for nuclear materials. Vol. I. Jones, O.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). pp 215-230 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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Because of the increasing incidence of terrorism, there is growing concern that nuclear materials and facilities need improved physical protection against theft, diversion, or sabotage. Physical protection systems for facilities or transportation which have balanced effectiveness include information systems, access denial systems, adequate and timely response, recovery capability, and use denial methods for despoiling special nuclear materials (SNM). The role of these elements in reducing societal risk is described; however, it is noted that, similar to nuclear war, the absolute risks of nuclear theft and sabotage are basically unquantifiable. Sandia Laboratories has a major US Energy Research and Development Administration (ERDA) role in developing advanced physical protection systems for improving the security of both SNM and facilities. These activities are surveyed in this paper. A computer simulation model is being developed to assess the cost-effectiveness of alternative physical protection systems under various levels of threat. Improved physical protection equipment such as perimeter and interior alarms, secure portals, and fixed and remotely activated barriers is being developed and tested. In addition, complete prototype protection systems are being developed for representative nuclear facilities. An example is shown for a plutonium storage vault. The ERDA safe-secure transportation system for highway shipments of all significant quantities of government-owned SNM is described. Adversary simulation as a tool for testing and evaluating physical protection systems is discussed. Finally, a list of measures is given for assessing overall physical protection system performance.

25430 Potentiality of an accounting system for nuclear materials in the PNC plutonium fuel facilities. Vol. I. Muto, T.; Aoki, M.; Tsutsumi, M.; Akutsu, H. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). pp 353-363 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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The accounting system based on data filing and inquiry processing by the use of an optical mark reader (OMR) has been developed and operated satisfactorily for criticality control and accountancy of nuclear materials in the plutonium facilities of the Power Reactor and Nuclear Fuel Development Corporation (PNC). The OMR system has merits, especially compared with an old chit and punch-card system, such as low cost, abundance of the data included on a single sheet, universality of use for all kinds of material transfers, ease of data correction, and a large capacity. The OMR system is applied to the material transfer and also for physical inventory taking. This system, together with the use of an accurate automatic balance equipped at each glove box, which is generally designated as an accounting unit for the criticality control, generated a MUF of 0.43% for a fuel fabrication campaign of 119 assemblies for a fast reactor, which can be decreased further. In relation to the recent safeguarding situation and also to fitting in with an automatic fuel fabrication process, however, a further

development of the present system will be necessary in the near future. This future system is discussed with reference to criticism of the current accountancy system by Rosenbaum and others, and its possible framework with the emphasis on the weighing and reading of numbered items is suggested.

25431 Some aspects of IAEA materials accountancy in relation to the future Euratom system. Vol. I. Schmitt, M.; Kschwendt, H. (Directorate of Euratom Safeguards, Luxembourg). pp 269-278 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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In view of the adaption of the present Euratom system to the requirements of the Verification Agreement, a discussion on some aspects of the IAEA nuclear materials accounting system is presented. The main differences between the two systems are identified. Based on Euratom's 15 years of experience, improvements and simplifications are proposed. The features of the future Euratom data processing system are described. Slightly modified report forms are proposed. The usefulness of having additional inventory change codes is discussed. Difficulties arising in the practical application of the batch concept are identified. Simplification of the exemption procedures is desirable. Shipper/receiver differences and the subdivision of facilities into MBAs for the sole purpose of accounting for these differences are discussed. Proposals for reducing delays in producing accounting results are made, which would not increase the work-load of the operator. In our opinion, several questions raised in this paper merit further discussion in order to define general rules and recommendations.

25432 Real-time material control concept for safeguarding special nuclear material in United States licensed processing facilities. Vol. I. Shea, T.E. (Nuclear Regulatory Commission, Washington, D.C. (USA)). pp 287-301 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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This paper describes general safeguards research being undertaken by the United States Nuclear Regulatory Commission. Efforts to improve the ability of United States licensed plants to contend with the perceived threat of covert material theft are emphasized. The framework for this improvement is to break down the internal control and accounting system into subsystems to achieve material isolation, inventory control, inventory characterization, and inventory containment analysis. A general programme is outlined to develop and evaluate appropriate mechanisms, integrate selected mechanisms into subsystems, and evaluate the subsystems in the context of policy requirements.

25433 Experience in safeguarding nuclear material at the Rheinsberg nuclear power station. Vol. I. Winkler, R. (VEB Kernkraftwerk Bruno Leuschner, Greifswald (German Democratic Republic). Betriebsteil Kernkraftwerk Rheinsberg). pp 183-185 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976). (In Russian)

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The three years' experience that has been gained in application of the Safeguards Agreement shows that the carrying out of inspections at the nuclear power plant has virtually no effect on operating conditions. In future it will be possible to reduce this effect even further and still maintain the operational reliability of the station. Verification of the transfer of nuclear material and detection of possible violations have proved relatively simple. The labour requirement of each unit at the station for the performance of inspections is not more that thirty man-days. Constructive collaboration between power station staff and inspectors is of great importance in improving the safeguards procedures.

CENTRIFUGATION

25434 Safeguards procedures for international transfers of nuclear materials. Vol. I. Skvortsov, S.A.; Miller, O.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). pp 597-607 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976). (In Russian)

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The general principles that can be used as a basis for the application of safeguards to international transfers of nuclear materials are described. The possibility of applying the principles to the transfer of nuclear materials in cladding or in bulk is considered.

25435 Verification of nuclear material accounts as a management function. Vol. I. Anderson, A.R.; Adamson, A.S.; Good, P.T.; Terrey, D.R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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UKAEA management has established a technically based Nuclear Materials Accounting Control Team (NMACT) whose responsibilities include verification of nuclear material holdings, independently of local management, at the six Authority establishments. This paper reviews the principles on which this technical verification work is based and discusses, where appropriate, the relevance to and differences from Safeguards' inspections. Preliminary results are presented on both record audit and physical verification activities at a fissile material store, a plutonium laboratory, a prototype power reactor, an experimental fuels laboratory, and a fuel fabrication plant.

25436 System design and evaluation for national safeguards systems. Vol. I. Bennett, C.A. (Battelle Human Affairs Research Center, Seattle, Wash. (USA)); Murphey, W.M. (Energy Research and Development Administration, Washington, D.C., USA. Div. of Safeguards and Security); Sherr, T.S. (Nuclear Regulatory Commission, Washington, D.C. (USA)). pp 115-132 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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This paper presents a structure of the safeguards problem that brings into context various aspects of the objective and scope of a national safeguards system. The "societal risk" approach is used to develop a comprehensive rationale for safeguards design and evaluation, the continuing systematic assessment of the safeguards system, and the allocation of safeguards resources. Within the objective of achieving or maintaining an acceptable level of risk, a nation can utilize this structure to design and implement a comprehensive and cost-effectve safeguards system. The combination of protective mechanisms which provides the desired degree of protection at minimum cost will depend on the total set of mechanisms legally, culturally, and technically available to a particular nation and on that nation's definition of the threat and consequences associated with the wilful misuse of nuclear material. While the basic elements of the problem and the broad internal concerns remain much the same from nation to nation, it should not be expected that the cost-effective solution matching appropriate protective mechanisms to all feasible adversary actions will be the same. Information on the effectiveness of the protective mechanisms with respect to each sub-objective and each part of the necessary action sequence will enable a balanced application of resources appropriate to the national circumstances.

25437 IAEA safeguards information system. Vol. I. Gmelin, W.R.; Parsick, R. (International Atomic Energy Agency, Vienna (Austria)). pp 251-267 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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The IAEA safeguards under the Non-Proliferation Treaty is meant to follow the model agreement developed by the Safeguards Committee in 1970 and formulated in document INFCIRC/153, which contains provisions that Member States, having concluded Safeguards Agreements with the Agency, should provide design information and reports on initial inventories, changes in the inventories and material balances in respect of each nuclear facility and material balance area for all nuclear materials subject to safeguards. The Agency, on the other hand, should establish and maintain an accountancy system which would provide the data on the location and the movements of all nuclear material subject to safeguards on the basis of the reported information and information obtained during inspections in order to support the Agency's verification activities in the field, to enable the preparation of safeguards statements and to adjust the inspection intensity. Following these requirements, a computer-based information system has been developed and is being implemented and used routinely for input manipulations and queries on a limited scale. This information system comprises two main parts: Part 1 for processing the information as provided by the States, and Part 2 (still under development) for processing the inspection data obtained during verification. This paper describes the characteristics of the Agency information system for processing data under the Non-Proliferation Treaty as well as recent operational experience.

25438 Experience in the application of Agency inspection practices. Vol. I. Nakicenovic, S. (International Atomic Energy Agency, Vienna (Austria)). pp 379-406 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

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The paper delineates the world-wide frame in which the Agency's safeguards are applied. It describes the composition and organization of the inspectorate, giving due emphasis to the role of the Country Officer. The methodology employed in tackling the problems of carrying out verification activities at a facility culminating in the preparation of a Safeguards Inspection Practice (SIP) is explained. The contents of a SIP are described as comprising a summary of all the factors to be considered, the approach conditioned by these considerations and any limitations on the effectiveness of the approach. It is noted that SIPs are also drawn up for each State as a whole to complement the practices for the individual facilities within the State. To illustrate the technical philosophy behind the preparation of these documents, typical situations are presented, e.g. as prevailing at a power reactor, a bulk fuel fabrication plant, at research reactors and other facilities. Mention is made of the analysis of diversion possibilities and means of concealment of diversion and some safeguards approaches and techniques are described. An indication is given of the limitations associated with some verification methods, and possible means of overcoming these limitations are suggested. The paper closes with an analysis of growth in the safeguards field based on past experience and a description of trends which have developed in this field. Special reference is made to the importance of the human factors involved in the implementation of safeguards.

25439 Safeguards - 1975-1985. Vol. I. Rometsch, R.; Lopez-Menchero, E.; Ryzhov, M.N.; Hough, C.G.; Panitkov, Yu. (International Atomic Energy Agency, Vienna (Austria)). pp 3-14 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

Implementation of safeguards requires translation of the conceptual objective into practical terms: actual values have to be defined for "significant quantity", "threshold amount", "detection probability", "confidence level", and "timeliness". Limitations are imposed on some of these criteria by the present status regarding nuclear material measurement and the mode of operation of nuclear facilities. A modified approach to verification based on categorization of nuclear material with the aim of limiting the growth of safeguards cost is presented for discussion.

25440 Accountancy, control and protection of nuclear material. Vol. I. Rometsch, R.; Lopez-Menchero, E.; Ryzhov, M.N.; Kurihara, H.; Hough, C.G. (International Atomic Energy Agency, Vienna (Austria)). pp 27-35 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

Clear distribution of responsibilities between the Agency, the States and the operators is fundamental. The Agency has the responsibility to establish and administer safeguards and to assist Member States, upon their request, to develop the means to solve problems arising from the use of atomic energy, one of them being the control of nuclear material. States have the responsibility, in respect to nuclear activities carried out within their territory, under their jurisdiction or under their control anywhere, to define appropriate measures to control nuclear material, to set up an organizational structure to enable the implementation of the measures and to control compliance with the law. This means that States establish systems for ensuring accountancy and control and physical protection of nuclear material. The paper gives an indication of the advice the Agency may give to States, which may request it, in setting up their systems of accountancy and control and physical protection of nuclear material. It also gives some ideas on the co-ordination of the States' systems, the relationship between the States and the Agency in the accountancy and control of nuclear material and the role of the Agency in the physical protection of nuclear material. The present irreplaceable role of the State as a regulatory power is stressed.

25441 Experience in the application of the Euratom Safeguards system in view of the introduction of the Verification Agreement. Vol. I. Schleicher, H.W.; Bommelle, P.; Miranda, U.; Schmitt, M.; Sharpe, B.W. (Directorate of Euratom Safeguards, Luxembourg). pp 59-70 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

A survey is given of the safeguards system of the European Community. Its legal basis, scope and size, as well as the operational means, are described. The procedures and techniques so far applied are analysed with respect to their suitability for the future. The existing structures and methods and the long and extensive experience will not only provide a solid basis for the introduction of the Verification Agreement, but will certainly also contribute to positive development during its practical application.

25442 Decision structure for a State safeguards system. Vol. I. Schleter, J.C. (National Bureau of Standards, Washington, D.C. (USA)). pp 199-213 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

An effective structure to direct safeguards decisions within a State's safeguards system is vital in order to minimize the possibility of illicit diversion of nuclear material. In a State each plant usually has some form of information system in operation but it is generally plant specific and often is directed only to management functions. The systematic study, discussed in this paper, is aimed at developing a more comprehensive Safeguards Information System (SIS). The concepts used are applicable to any State's safeguards system. Decision makers are identified and classified. General safeguards and operational tasks are defined for each and, based on these, information sources are identified. The flow structure for information is specified to enable safeguards decision makers to function properly. Concepts used to characterize the SIS and the associated decision structure are discussed.

LASER EXCITATION

REFER ALSO TO CITATION(S) 26339

25443 (LA—6358-C) ERDA/LASL lasers for isotope separation conference, Albuquerque, New Mexico, April 13—14, 1976. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1976. Contract W-7405-Eng-36. 117p. (CONF-760439—). Dep. NTIS $5.50.

From LASL-LIS conference; Albuquerque, New Mexico, United States of America (USA) (13 Apr 1976).

Abstracts of the papers presented at the Lasers for Isotope Separation Conference are included. (LK)

25444 Multiple particle type interaction isotopically selective ionization. (to Jersey Nuclear-Avco Isotopes, Inc.). Netherlands Patent 7,505,595/A/. 13 May 1975. 20p. (In Dutch).

Priority 13 May 1974, USA; 3 figs.

A method and apparatus for the impact ionization of particles excited with isotopic selectivity is discussed, particularly for use in a system of uranium isotope separation and enrichment. Efficient impact ionization is achieved by first selectively exciting vaporized particles of the desired isotope in a beam of finely tuned laser radiant energy. The energies of the interacting photons are selected to produce a total energy shift during excitation which is slightly less than the ionization energy for the selected isotope. The excited isotope will thus be raised to an excitation level only slightly below the ionization level. This level is selected to permit efficient ionization and particle collisional ionization between energetic particles in the uranium vapor environment and the highly excited particles of the desired isotope type.

25445 Suppression of unwanted lasing in laser isotope separation. (to Jersey Nuclear-Avco Isotopes, Inc.). Netherlands Patent 7,507,452/A/. 23 Jun 1975. 15p. (In Dutch).

Priority 25 Jun 1974, USA; 5 figs.

Frequency selective means, particularly for use in uranium enrichment by laser-induced isotopically selective ionization to suppress unwanted lasing of the excited uranium medium is described. The frequency selective means such as filters, are placed at intervals in a column of laser illuminated uranium vapor and are transmissive to the illuminating laser frequencies but non-transmissive to frequencies at which population inversions exist in the excited uranium. The filters limit the path length and correspondingly the gain in the excited uranium to prevent high intensity lasing by the uranium itself.

25446 Method of separating isotopes. Levy, R.H.; Janes, G.S. (to Jersey Nuclear-Avco Isotopes, Inc.). Canadian Patent 974190. 9 Sep 1975. 15p.

Available from Commissioner of Patents, Ottawa.

A method of separating isotopes, especially of uranium, is described. A beam of atoms is excited with radiation from widely available tunable dye lasers, the preferentially excited isotope atoms are preferentially ionized by absorption of a second photon

from the lasers, and the ions are given an energy of at last one eV and subsequently separated from the atomic beam by known means.

25447 Isotope separation utilizing Zeeman compensated magnetic extraction. Forsen, H.K. (to Jersey Nuclear-Avco Isotopes, Inc.). US Patent 3,953,731. 27 Apr 1976. Filed date 27 Dec 1973. 10p.

A method and apparatus are described for creating a plasma of ions of one isotope type and magnetically extracting the ions from the plasma without impairing the ionization selectivity and efficiency. In a particle flow of plural isotope types, radiant energy is applied to selectively excite and ionize ions of at least one isotope type without corresponding ionization of particles of other isotope types. A magnetic field is applied to divert the ions of the one isotope type sufficiently to permit separate collection of those ions without the other particle constituents of the flow. The system of the invention balances the requirements for a high magnetic field to provide sufficient diversion before charge exchange with the requirement for a limited magnetic field to prevent interference with the selective ionization process due to Zeeman broadening of the isotope absorption lines. 25 claims, 8 drawing figures.

BY-PRODUCTS

DEPLETED URANIUM

REFER ALSO TO CITATION(S) 26040

25448 (AD-A—010351) **Machinability program for depleted uranium alloy penetrators. Project report.** Knight, E.R. (Lake City Army Ammunition Plant, Independence, Mo. (USA). Ammunition Technology Div.). Nov 1974. 40p. (ATD—74-2). NTIS $3.75.

The objective of this machinability program was to determine the machining characteristics of two DU alloys: 0.75% Ti and 0.75% Quad. The effects of relatively small changes in the composition of a given DJ alloy on machinability, the machine speeds and feeds to be used in the machining of DU alloys, and the effects of negative and positive rake on tool design were to be established. This data was required in order to determine if penetrators could be made satisfactorily on multi-spindle automatic screw machines. This data would also be used in preparing a cost estimate for establishing a production line for 1,000,000 penetrators at the rate of 100,000 per month for 10 months on a 1-shift/8-hour day/5-day week/20-day month.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 25456, 25475, 25498, 26079

25449 (BARC/I—348) **Specification analysis of plutonium fuels for non-metallic impurities. I. Estimation of carbon.** Rizvi, G.H.; Sethuraman, P.R.; Venkataramana, P.; Natarajan, P.R. (Bhabha Atomic Research Centre, Bombay (India)). 1975. 6p. INIS.

15 refs., 4 tables, 2 figures.

An analytical method for the estimation of carbon in plutonium samples in the range of 10-400 μg by conductometry has been developed. In the first step of the method, the entire carbon in sample is converted into CO_2 which in the second step is completely absorbed in barium hydroxide solution in conductivity of the solution.

25450 (JAERI-M—5829, pp 107-120) **Application of neutron spectroscopy to ceramic fuels.** Nasu, S. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Experimental results of the neutron spectroscopy on neodymium monopnictides are explained. The Q (scattering vector) dependence and temperature dependence of a neutron intensity spectrum decide whether the observed energy spectrum is due to crystal field transition or phonon scattering. In case of the crystal field transition, the intensity decreases with increase of the scattering vector Q, whereas the spectrum intensity increases with the Q in case of the phonon scattering. The experiment was performed at "Riso", Denmark, with a triple-axis spectrometer. The neutron wave length used was 4.06A, and neutrons were detected with a position sensitive ^{3}H counter. Energy spectra of neutrons scattered from polycrystalline NdP and NdAs at 120K and NdSb at 120K and 290K were obtained, and shown in figures. Identification of transition was carried out. Transition energy, peak width, and peak intensity were obtained. Crystal field parameters are summarized in a table. The Schottky specific heat deduced from the results of neutron spectroscopy was in good agreement with that obtained by Aeby et al.. Study of actinide compounds by the neutron spectroscopy is discussed.

25451 (JAERI-M—5829, pp 93-99) **Radiation effects on ceramic fuels. Fission damage and fission gas voids.** Kikuchi, T. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Several researches made on fission fragment damage, and the formation and growth of fission gas bubbles in the course of swelling are introduced and discussed on UO_2 and UC. The observation of lattice defects, the change of lattice constant and the behavior of creep as the result of fission fragment damage are described, and the combination of direct observation and physical property measurement is believed to be important in order to explain the creep phenomena of technological significance. The formation and growth of fission gas bubbles have been investigated, and the nucleation-agglomeration theory was proposed by Whapham. The swelling rate that is the rate of increase in volume or radius of fuel bulk is technologically necessary for the analysis of the mechanical interaction between fuel and fuel sheaths of fuel pins. Since the irradiation conditions of fuel pins are not so simple that the swelling rate of actual fuel bulk is not readily evaluated. The exact evaluation of the basic course of swelling will be more and more useful, though the modeling of various fuel pins has been and is being proceeded. A picture of interlattice loop and void lattice loop of UO_2 and pictures of fission gas bubbles of UO_2 are presented. Curves of lattice constant, bubble concentration, temperature dependence of creep speed of UO_2, etc. are also included.

25452 (ORNL-tr—4180) **Preparation of uranium—plutonium mixed carbide.** Wedemeyer, H.; Guenther, E. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). 1974. Translation by R.G. Mansfield of report KFK—2238. 39p. Dep. NTIS $4.00.

The carbide fuel fabrication line of the Institut fuer Material- und Festkoerperforschung (IMF) is presented. The carbide fabrication by carbothermic reduction as well of original produced urania-/plutonia-Powders as of sintered oxide waste is described. Test results of the stoichiometry behavior and of the reduction of plutonium losses are given. Reduction of losses is possible by an early step of formation of mixed crystals within the carbide fabrication process. It seems possible to decrease the total material-loss to values lower than 1 wt percent if the batch size is large enough. 36 fig, 5 tables.

25453 Method for manufacturing uranium dioxide and uranium oxide powders. DeHollander, W.R.; Fenimore, C.P. (to General Electric Co.). French Patent 2,240,187/A/. 7 Aug 1974. 38p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France); priority claim: 10 Aug 1973, USA.

The method consists in introducing into the reaction zone, a first gaseous reactant constituted by a mixture of uranium hexafluoride with a reducer gas, separately introducing into the reaction zone a second gaseous reactant constituted by an oxygen containing gas and separately introducing into the reaction zone a gas forming a barrier between these first and second gaseous reactants until a sufficient transverse diffusion of the reactants has occurred in said barrier-forming gas. This can be applied to the manufacture of uranium dioxide.

25454 Method and device for generating spherical particles. (to UKAEA). French Patent 2,240,046/A/. 7 Aug 1974. 13p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France); priority claim: 8 Aug 1973, UK.

The invention relates to the generation of spherical particles. Its object is an apparatus for forming particles characterized in that it comprises a device for forming droplets from a liquid, a device adapted to cause electric charges to appear on the droplets thus formed by said droplet forming device, all of said charges being of the same polarity, and a device adapted to transform the droplets into particles. This can be applied to the generation of nuclear fuel spherical particles.

25455 Production of sized particles of uranium oxides and uranium oxyfluorides. Knudsen, I.E.; Randall, C.C. (to Westinghouse Electric Corp.). Canadian Patent 973684;. 2 Sep 1975. 15p.

Available from Commissioner of Patents, Ottawa.

A process for converting uranium hexafluoride to uranium dioxide of a relatively large particle size in a fluidized bed reactor

by mixing uranium hexafluoride with a mixture of steam and hydrogen to form a mixture of uranium oxide and uranium oxyfluoride seed particles of varying sizes, separating the larger particles from the smaller particles in a cyclone separator, recycling the smaller seed particles through the ejector to increase their size, and introducing the larger seed particles from the cyclone separator into a fluidized bed reactor where the seed particles serve as nuclei on which coarser particles of uranium dioxide are formed.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 25470, 25474, 25480, 25483, 26223

25456 (BN—7506-01) **Production and industrial applications of plutonium.** Lafontaine, I. (Societe Belge pour l'Industrie Nucleaire, Brussels). 1975. 14p. (In French). INIS.

An evaluation is made of the quantities of plutonium which will be produced by all nuclear power stations until 1980 and of the plants which are actually able to process burned nuclear fuels to recover this material. As soon as the plutonium, in the form of dioxide, becomes available, it is transported to fuel rod and fuel assembly fabrication plants, in containers especially commissioned by the competent authorities; these containers very severe tests specified by the International Atomic Energy Agency in Vienna. Additional protections are foreseen during transportation, namely to prevent an attempt of nuclear materials' diversion. The plant for fabrication of nuclear fuels is designed on the basis of extensive safety studies. Indeed, various probabilities of accidents and associated risks have been evaluated and have given rise to safe working rules and the provision of elements of protection.

25457 (DOCKET-701701—1) **West Valley UF_6 Facility. Environmental report and safety evaluation, supplement 1.** (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). 18 Aug 1975. 114p. Dep. NTIS $9.00.

Revised pages are provided for the Environmental Report and the Safety Evaluation Report which reflect design changes and more detailed information on the items requested in the USAEC letter to NFS dated September 6, 1974. (LK)

25458 (DPSPU—76-30-9) **SRP sand filter: more than a pile of sand.** Orth, D.A.; Sykes, G.H.; Schurr, G.A. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Plant). Jul 1976. Contract AT(07-2)-1. 16p. (CONF-760822—7). Dep. NTIS $3.50.

From 14. US ERDA air cleaning conference; Sun Valley, Idaho, United States of America (USA) (2 Aug 1976).

Sand filters at the two SRP separations plants have operated well for over twenty years, displaying steadily increasing efficiency for removal of activity. Pressure drop remained low on one filter although some sand was removed from the other to counteract rising pressure drop due to salts in the bed. Activity is not migrating through the beds and such breakthrough does not appear to be a life-limiting phenomenon. The underbed supports and air distribution systems were weakened by acid attack and erosion, with localized failure, prompting construction of new filters. Design studies and tests defined relations between sand characteristics, airflow resistance, and filtration efficiency. Appropriate sands were selected and monitored during construction to ensure that the new filters would have satisfactory efficiency, airflow, and pressure drop at startup.

25459 (ORNL/TM—5091) **Separation of silicon carbide-coated fertile and fissile particles by gas classification.** Vaughen, V.C.A. (Oak Ridge National Lab., Tenn. (USA)). Jul 1976. Contract W-7405-eng-26. 28p. Dep. NTIS $4.00.

The separation of ^{233}U and ^{233}U in the reprocessing of HTGR fuels is a key feature of the feed-breed fuel cycle concept. This is attained in the Fort St. Vrain (FSV) reactor by coating the fissile (Th-^{235}U) particles and the fertile (Th-^{233}U) particles separately with silicon carbide (SiC) layers to contain the fission products and to protect the kernels from burning in the head-end reprocessing steps. Pneumatic (gas) classification based on size and density differences is the reference process for separating the SiC-coated particles into fissile and fertile streams for subsequent handling. Terminal velocities have been calculated for the +- 2 sigma ranges of particle sizes and densities for "Fissile B"—"Ferti le A" particles used in the FSV reactor. Because of overlapping particle fractions, a continuous pneumatic separator appears infeasible; however, a batch separation process can be envisioned. Changing the gas from air to CO_2 and/or the temperature to 300°C results in less than 10 percent change in calculated terminal velocities. Recently reported work in gas classification is discussed in light of the theoretical calculations. The pneumatic separation of fissile and fertile particles needs more study, specifically with regard to (1) measuring the recoveries and separation efficiencies of actual fissile and fertile fractions in the tests of the pneumatic classifiers; and (2) improving the contactor design or flowsheet to avoid apparent flow separation or flooding problems at the feed point when using the feed rates required for the pilot plant.

25460 (ORNL/TM—5538) **Potential generation and radiological impacts of gaseous ^{14}C released during reprocessing of advanced LMFBR fuels.** Tennery, V.J.; Bomar, E.S.; Bond, W.D.; Kaye, S.V.; Morse, L.E.; Till, J.E. (Oak Ridge National Lab., Tenn. (USA)). Jun 1976. Contract W-7405-eng-26. 28p. AT.

Use of advanced carbide or nitride fuels in place of the reference oxide fuel in LMFBRs may be required in the future to optimize the utilization of this reactor system. Differences in the environmental impact associated with such fuel substitutions are of critical importance in determining the real future viability of various advanced fuels. Calculations indicate that the concentration of ^{14}C can be significantly different in the various fuels following their residence in the reactor. Most of the ^{14}C present in the spent fuels is converted to $^{14}CO_2$ during fuel reprocessing, and ^{14}C released to the environment will be in this form. Best estimates indicate a release to the environment of no more than 1 percent of the ^{14}C contained in the spent fuels. Radiation dose commitments due to $^{14}CO_2$ release from advanced-fuel reprocessing plants were calculated. They range between 1.5×10^{-6} mrem from nitride fuel containing no ^{14}N to a maximum of 50 mrem from nitride fuel synthesized with natural nitrogen. Population doses within an 80-km (50-mile) radius of the reprocessing plant were calculated to be 13 man-rems for carbide fuel containing 1000 ppm ^{14}N and 760 man-rems for nitride fuels synthesized from natural nitrogen.

25461 (ORNL/TM—5547) **LWR Fuel Reprocessing and Recycle Program quarterly report, April 1—June 30, 1976.** (Oak Ridge National Lab., Tenn. (USA)). Jul 1976. Contract W-7405-eng-26. 96p. Dep. NTIS $5.00.

This quarterly report is the second in a series to be issued on the LWR Fuel Reprocessing and Recycle Program at ORNL as part of the national program administered by Savannah River Operations-Savannah River Laboratory. Several more dissolutions were made using irradiated fuel from the H. B. Robinson II reactor. Characterization of the solids and the resulting solutions is in progress and will be reported in the next quarterly. Requests for bids have been issued for the design and fabrication of a model 1/2 ton-per-day voloxidizer. Two mixer-settler units have been installed in the laboratory, and reference flowsheet studies using synthetic solutions have been initiated. The Fluorocarbon Absorption Studies program was expanded during this quarter to include acceleration of the pilot-plant development, the initiation of plant engineering design criteria, continuance of a system reliability analysis, and a study of the chemical effects of impurities in the fluorocarbon solvent on the process and equipment. Calculations have been made to provide mass balance data for a three-region PWR through successive recycle of self-generated plutonium.

25462 **Technical and economic problems of nuclear fuel reprocessing.** Valvoda, Z. *Jad. Energ.*; **22**: No. 3, 112-118(Mar 1976). (In Czech).

A survey is presented of nuclear fuel reprocessing problems with a view to the significance, history and the current state of reprocessing. Factors stipulating international cooperation are discussed and some results are given of cooperation between capitalist countries. Data are tabulated on constructed, projected or reconstructed reprocessing plants in the capitalist countries. The conclusion is arrived at that the lack of reprocessing capacities for highly irradiated oxide fuels may, in the future, be only coped with by constructing new reprocessing plants, this in harmony with projecting and constructing nuclear power installations.

25463 **Method of stripping plutonium from tributyl phosphate solution which contains dibutyl phosphate-plutonium stable complexes.** Ochsenfeld, W.; Schmieder, H. (to Gesellschaft fuer Kernforschung mbH). US Patent 3,949,049. 6 Apr 1976. Priority date 13 Mar 1968, German, Federal Republic of (F.R. Germany). 6p.

Fast breeder fuel elements which have been highly burnt-up are reprocessed by extracting uranium and plutonium into an organic solution containing tributyl phosphate. The tributyl phosphate degenerates at least partially into dibutyl phosphate and monobutyl phosphate, which form stable complexes with tetravalent plutonium in the organic solution. This tetravalent plutonium is released from its complexed state and stripped into aqueous phase by contacting the organic solution with an aqueous phase containing tetravalent uranium. 6 claims, 1 drawing figure.

25464 **Treatment of irradiated nuclear fuel.** Bernard, C. (to Saint-Gobain Techniques Nouvelles). US Patent 3,954,654. 4 May 1976. Priority date 18 May 1973, France. 12p.

A method for reprocessing spent irradiated nuclear fuels containing uranium, plutonium, tritium, and fission products is described. The spent fuel is sheared into fragments and then dissolved in nitric acid to form an aqueous solution including tritium in the form of tritiated water. The aqueous solution is extracted with a suitable organic solvent to separate the uranium, plutonium, a major portion of the fission products, and the tritiated water. The organic phase is washed with two washes - the second substantially smaller in volume than the first-of dilute aqueous nitric acid to render the organic phase virtually free of tritium. The tritium-free organic phase is extracted with a suitable aqueous phase to transfer the uranium, plutonium, and residual fission products to the aqueous phase. The organic phase is then treated first with a sodium carbonate solution and then with alternating alkaline and acid aqueous solutions to render the organic phase suitable for recycling. All fractions containing fission products are treated to concentrate and optionally solidify the fission products. The tritiated water is separated from the aqueous nitric acid making it suitable for recycling. (BLM)

TRANSPORT AND STORAGE

25465 (CONF-760813—3) **Evaluation of criticality criteria for Class II packages in transportation.** Thomas, J.T. (Oak Ridge National Lab., Tenn. (USA)). 1976. Contract W-7405-eng-26. 6p. Dep. NTIS $3.50.

From Symposium on the design, construction and testing of packaging for the safe transport of radioactive materials; Vienna, Austria (23 Aug 1976).

Calculations were made for U(93.2) and typical insulation materials (celotex) in ideal cubic arrays under various reflector conditions (three- and six-sided water and concrete). The reflector effect is greatly reduced because of the packaging materials. It is concluded that transportation criteria for criticality assessment of Class II packages have practical bases and that mass limits based on air-spaced units are suitable as mass limits for packages. (DLC)

MARKETING AND ECONOMICS

25466 (INIS-mf—3039) **Uranium.** Stewart, E.D.J. (Australasian Inst. of Mining and Metallurgy, Parkville (Australia)). 1974. 32p. INIS.

From Symposium on energy resources in Australia; Canberra, Australia (8 Nov 1974).

18 figs.

A discussion is given of uranium as an energy source in The Australian economy. Figures and predictions are presented on the world supply-demand position and also figures are given on the added value that can be achieved by the processing of uranium. Conclusions are drawn about Australia's future policy with regard to uranium.

WASTE MANAGEMENT

25467 (ZfK—285) **Investigation of counter-measures in the case of radioactive materials penetration in soils and ground water.** Sachse, G.; Anders, G.; Puehrer, H.; Stohn, W. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Mar 1975. 69p. (In German). INIS.

Proceeding from the methods known from hydraulic engineering for the protection of ground waters from penetrating noxious substances, suitable measures for preventing the contamination of ground waters and soils are discussed. Since preventive measures are always of priority, a facility using concrete containers with double walls is considered to be an appropriate method for temporary storage of low and medium activity waste waters.

25468 **Radioactive waste management in nuclear-electric power generation.** Sakata, S. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). *Nenryo Kyokai-shi;* **54**: No. 577, 306-313(May 1975). (In Japanese).

The cognition for dealing with the radioactive waste has reached the waste management concept through the treatment and disposal from the simple disposal of the early stage. In nuclear-electric power generation system, many sorts of radioactive waste are generated from not only power stations but their related nuclear fuel cycle facilities. Two technical objectives have to be aimed in the waste treatment step: one is diminution of the release rate of radioactivity into the environment in fluid form and the other is conditioning (solidification and packaging) of volume-reduced or concentrated wastes including both the solid waste and wastes originated from the decommissioning of nuclear facilities. In this moment, endeavors dedicated for the diminution of release rate gives fairly good performances based on the "As Low As Practicable" principle, but for the conditioning. Hereafter, much efforts will be concentrated on the following aspects, for example, diminution of amount of the wastes to be solidified or packaged, realization of high volume reduction, and establishing the appropriate guidelines for packaging together with the consolidation of responsibility and financial liability.

WASTE PROCESSING

25469 (BNWL—1926) **Partitioning of long-lived nuclides from radioactive waste. FY 1975 annual report.** Wheelwright, E.J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1976. Contract E(45-1)-1830. 56p. Dep. NTIS $4.50.

The status of the following studies is reported: characterization and treatment of solids in high-level waste; removal of long-lived nuclides from solidified waste and non-high-level wastes; development of low-additive flowsheets for removing long-lived nuclides from the fission products; evaluation of incentives for partitioning; and comparison of waste management systems with and without partitioning. (LK)

25470 (CONF-760806—6) **Airborne effluent control for LMFBR fuel reprocessing plants.** Yarbro, O.O.; Groenier, W.S.; Stephenson, M.J. (Oak Ridge National Lab., Tenn. (USA); Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 1976. 22p. Dep. NTIS $3.50.

From Meeting on controlling airborne effluents from fuel cycle plants; Sun Valley, Idaho, United States of America (USA) (5 Aug 1976).

A significant part of the LMFBR fuel reprocessing development program has been devoted to the development of efficient removal systems for the volatile fission products, including ^{131}I, krypton, tritium, ^{129}I, and most recently ^{14}C. Flowsheet studies have indicated that very significant reductions of radioactive effluents can be achieved by integrating advanced effluent control systems with new concepts of containment and ventilation; however, the feasibility of such has not yet been established, nor have the economics been examined. This paper presents a flowsheet for the application of advanced containment systems to the processing of LMFBR fuels and summarizes the status and applicability of specific fission product removal systems.

25471 (CONF-760822—4) **Experimental studies on the krypton absorption in liquid CO_2 (KALC) process.** Glass, R.W.; Beaujean, H.W.R.; Fowler, V.L.; Gilliam, T.M.; Inman, D.J.; Levins, D.M. (Oak Ridge National Lab., Tenn. (USA)). 1976. 22p. Dep. NTIS $3.50.

From 14. US ERDA air cleaning conference; Sun Valley, Idaho, United States of America (USA) (2 Aug 1976).

Results are presented for a series of experiments to quantify krypton removal from simulated High-Temperature Gas-Cooled Reactor reprocessing off-gas by the KALC process. The Experimental Engineering Section Off-Gas Decontamination Facility used in the campaign provides engineering-scale experiments with nominal gas and liquid flows of 5 scfm and 0.5 gpm respectively. Equilibrium and nonequilibrium mass transfer experiments for the CO_2—O_2—Kr system are described. Data analysis indicates values of HTU for krypton on the order of 0.5 ft for decontamination factors from 100 to 10,000. Recent flooding information for the packed columns is combined with previous data and is shown to be well represented by an empirical flooding equation.

25472 (HEDL-SA—851) **Treatment technologies for non-high-level wastes (USA).** Cooley, C.R.; Clark, D.E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1976. Contract E(45-1)-2170. 77p. (CONF-760701—4). Dep. NTIS $5.00.

From International symposium on management of waste from the LWR fuel cycle; Denver, Colorado, United States of America (USA) (11 Jul 1976).

Non-high-level waste arising from operations at nuclear reactors, fuel fabrication facilities, and reprocessing facilities can be treated using one of several technical alternatives prior to storage. Each alternative and the associated experience and status of development are summarized. The technology for treating non-high-level wastes is generally available for industrial use. Improved techniques applicable to the commercial nuclear fuel cycle are being developed and demonstrated to reduce the volume of waste and to immobilize it for storage. 36 figures, 59 references.

25473 (HEDL-SA—856) **Technologies for recovery of transuranics and immobilization of non-high-level wastes.** Richardson, G.L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1976. Contract E(45-1)-2170. 58p. (CONF-760701—5). Dep. NTIS $4.50.

From International symposium on management of waste from the LWR fuel cycle; Denver, Colorado, United States of America (USA) (11 Jul 1976).

This paper supplements the preceding Symposium paper on "Treatment Technologies for Non-High-Level Wastes (U.S.A.)" by C. R. Cooley and D. E. Clark (HEDL-SA-851), and covers the additional treatment technologies in use and under development for recovering transuranics and immobilizing non-high-level wastes for transportation and storage. Methods used for nondestructive assay (NDA) of TRU elements in non-high-level wastes are also discussed briefly.

25474 (JAERI-M—6106) **Recovery, purification and concentration of plutonium and americium from the aqueous wastes discharged in the reprocessing process studies. Technical report.** Tsujino, T.; Hoshino, T.; Yasu, S.; Kawashima, Y. (Japan Atomic Energy Research Inst., Tokyo). Apr 1975. 31p. (In Japanese). INIS.

For recovering and purifying plutonium and americium from the aqueous wastes occurring in the process studies on reprocessing, a standard procedure has been established for use in the laboratory works, through the preliminary tests of the precipitation as hydroxides and the anion exchange in nitrate media. The procedure was proven in the treatment of actual wastes, of which the results were contributed to determine the process conditions in the plutonium purification and product concentration of the JAERI Reprocessing Test Plant. The preliminary tests also include washing of U and Am recovery from the anion-exchanger in nitrate media, direct ion-exchange recovery of Pu from the TBP phase and elution of Am from the cation-exchanger.

25475 (K-C—1241) **Airborne effluent control at fuel enrichment, conversion, and fabrication plants.** Mitchell, M.E. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 1976. Contract W-7405-eng-26. 26p. (CONF-760806—2). Dep. NTIS $4.00.

From Meeting on controlling airborne effluents from fuel cycle plants; Sun Valley, Idaho, United States of America (USA) (5 Aug 1976).

Uranium conversion, enrichment, and fuel fabrication facilities generate gaseous wastes that must be treated prior to being discharged to the atmosphere. Since all three process and/or handle similar compounds, they also encounter similar gaseous waste disposal problems, the majority of which are treated in a similar manner. Ventilation exhausts from personnel areas and equipment off-gases that do not contain corrosive gases (such as HF) are usually passed through roughening and/or HEPA filters prior to release. Ventilation exhausts that contain larger quantities of particles, such as the conversion facilities' U_3O_8 sampling operation, are passed through bag filters or cyclone separators, while process off-gases containing corrosive materials are normally treated by sintered metal filters or scrubbers. The effectiveness of particle removal varies from about 90 percent for a scrubber alone to more than 99.9 percent for HEPA filters or a combination of the various filters and scrubbers. The removal of nitrogen compounds (N_2, HNO_3, NO/sub x/, and NH_3) is accomplished by scrubbers in the enrichment and fuel fabrication facilities. The conversion facility utilizes a nitric acid recovery facility for both pollution control and economic recovery of raw materials. Hydrogen removal from gaseous waste streams is generally achieved with burners. Three different systems are currently utilized by the conversion, enrichment, and fuel fabrication plants to remove gaseous fluorides from airborne effluents. The HF-rich streams, such as those emanating from the hydrofluorination and fluorine production operations of the conversion plant, are passed through condensers to recover aqueous hydrofluoric acid.

25476 (LA—6252) **Incineration facilities for treatment of radioactive wastes: a review.** Perkins, B.L. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1976. Contract W-7405-Eng-36. 98p. Dep. NTIS $5.00.

A description is given of incinerator installations in the US and in foreign countries. Included are descriptions of inactive incinerators, incinerator facilities currently in operation, and incinerator installations under construction. Special features of each installation and operational problems of each facility are emphasized. Problems in the incineration of radioactive waste are discussed in relation to the composition of the waste and the amount and type of radioactive contaminant.

25477 (LA-UR—76-1515) **Controlled-air incineration of transuranic-contaminated solid waste.** Borduin, L.C.; Draper, W.E.; Koenig, R.A.; Neuls, A.S.; Warner, C.L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-eng-36. 15p. (CONF-760822—14). Dep. NTIS $3.50.

From 14. US ERDA air cleaning conference; Sun Valley, Idaho, United States of America (USA) (2 Aug 1976).

A controlled-air incinerator and an associated high-energy aqueous off-gas cleaning system are being installed at the Los Alamos Scientific Laboratory (LASL) Transuranic Waste Treatment Development Facility (TDF) for evaluation as a low-level transuranic-contaminated (TRU) solid waste volume reduction process. Program objectives are: (1) assembly and operation of a production scale (45 kg/hr) operation of "off-the-shelf" components representative of current incineration and pollution control technology; (2) process development and modification to meet radioactive health and safety standards, and (3) evaluation of the process to define the advantages and limitations of conventional technology. The results of the program will be the design specifications and operating procedures necessary for successful incineration of TRU waste. Testing, with nonradioactive waste, will begin in October 1976. This discussion covers commercially available incinerator and off-gas cleaning components, the modifications required for radioactive service, process components performance expectations, and a description of the LASL experimental program.

25478 (LRD—10/75) **Retention of gaseous fission products by pure and modified activated carbon.** Wilhelmova, L.; Cejnar, F. (Ceskoslovenska Akademie Ved, Prague. Laborator Radiologicke Dozimetrie). Jan 1975. 21p. (In Czech). INIS.

The results are reported of research into Czechoslovak-made activated carbon Desorex DB-2 and Supersorbon HS-1 and their retention properties. Krypton, xenon and helium of spectral purity were used in the investigation. The effect of surface impregnation was also studied on the retention efficiency of the activated carbon. It was found that the impregnation with alkali metal fluorides, such as RbF and CsF favourably affected the retention properties of the activated carbon as concerns gaseous fission products.

25479 (NLCO—1132) **Feasibility study of a portable smelter for scrap metals.** Cavendish, J.H. (ed.). (National Lead Co. of Ohio, Cincinnati (USA)). Jun 1976. Contract E(30-1)-1156. 97p. Dep. NTIS $5.00.

The use of a portable smelter to process uranium-contaminated scrap metals was studied. Objectives were to convert scrap metal located at many diverse sites into a form which would be suitable for unlicensed sale and reduce the problems associated with storing the scrap. The Foundry Design Company study indicated the portable smelter concept was feasible from an equipment and transportation standpoint. Capital costs for a 5-ton/hour (steel) nominal capacity unit were estimated to be $2,349,000. Technical evaluation indicates that all the common metals considered, i.e., iron, nickel, copper, and aluminum, are amenable to uranium decontamination by smelting except aluminum. An economic evaluation of the processing of the 30,000 tons of steel scrap to be generated by the Cascade Improvement Program by a portable smelter was made based upon information supplied by Foundry Design Company, plus the assumption that the product metal could be sold for $120.00 per ton. This evaluation indicated a net return of $2,424,000 to the government could be realized. The Health and Safety study indicated no major problems of this nature would be encountered in operating a portable smelter. The legal review indicated the proposed operation fell within the authority of existing regulations. Consideration of possible conflicts with regard to competition with the private sector was suggested. (DLC)

25480 (SAND—76-5396) **Inorganic ion exchange process for partitioning high level commercial waste.** Schwoebel, R.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 8p. Dep. NTIS $3.50.

Aspects of the Sandia Solidification Process that pertain to the concept of waste partitioning are covered. The general chemistry of the Sandia Solidification Process is reviewed. Experimental observations that relate to the separation of actinides from rare earths are presented. (LK)

25481 (SGAE—2518) **The bitumination of solid radioactive residues by sedimentation in the final storage vessel.** Knotik, K.; Leichter, P.; Jakusch, H.; Glock, J. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Nov 1975. 10p. (In German). (CH—174/75). INIS.

From 4. International Fair of Nuclear Industries and Technical Meetings NUCLEX 75; Basel, Switzerland (7 Oct 1975).

Experiencess obtained with the sedimentation technique during trial solidification of nonactive evaporation residues in bitumen is presented. The properties of the final product as well as improvements to reach continuous operation together with simplified decontamination are discussed.

25482 (UNI-SA—34) **Management of low-level radioactive waste in United Nuclear Industries, Inc., managed facilities.** Dabrowski, T.E. (United Nuclear Industries, Inc., Richland, Wash.

(USA)). 24 Jun 1976. Contract AT(45-1)-1857. 14p. Dep. NTIS $3.50.

The basic sources of radioactive waste from N Reactor, the treatment and handling systems for these wastes, and the impact of the radioactive waste discharges on the environs are described. (LK)

25483 Method for recovering and separating palladium, technetium, rhodium and ruthenium contained in solutions resulting from nuclear fuel recycling. Moore, R.H. (to USAEC, Washington). French Patent 2,236,786/A/. 10 Jul 1974. 10p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France); priority claim: 12 Jul 1973, USA.

The invention relates to a method for recovering and separating technetium and metals of the platinum group, i.e. palladium, rhodium and ruthenium existing as fission products. The method according to the invention is characterized by contacting a residuary acid aqueous solution provided by nuclear fuel recycling with successive carbon beds which have adsorbed different chelating agents specific for the metals to be recovered in order that said metals be selectively chelated and extracted from the solution. This method is suitable for recovering the above metals from solutions provided by reprocessing spent fuels.

25484 Material composition of the low level radioactive solid waste. Machida, C.; Suzuki, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). *Hoken Butsuri;* **10**: No. 1, 17-21(Mar 1975). (In Japanese).

The survey of material composition of the low level radioactive solid waste was performed in connection with the design work of the new incinerator in Tokai Establishment, JAERi. Five large facilities were selected as the representation of more than 20 facilities, and 500 packages were chosen out of 2,189 packages discharged during 2 months, June and July 1973. They consisted of the combustible and compressible waste but not included filters and contaminated equipments. The survey showed following result; plastics 33%, waste cloth 24%, paper 18%, rubber 9%, clothes 5%, timber 1% (total of above mentioned materials 89%), metal 7%, glass 2%, concrete and sand 2%. Eighty-nine % of the total quantity is combustible material in principle, then it will be expected that the incineration treatment get a wider application to reduce the volume of final disposal.

25485 Method for removing radioactive iodine and radioactive organic iodides from effluent gases. (to American Air Filter Co., Inc.). Netherlands Patent 7,504,015/A/. 4 Apr 1975. 10p. (In Dutch).

Priority 18 Jul 1974, USA.

A method and composition for removing radioactive and organic iodides from an ^{131}I-containing off-gas stream is provided. The composition for removal by adsorption is a ceramic material with a surface area of from about 5 m^2/g to about 250 m^2/g impregnated with a metallic salt. The method for removing the iodine or iodide is accomplished by passing the off-gas stream over the ceramic material impregnated with the metallic salt. It finds special application in air filters for nuclear power plants.

25486 Incorporation of radioactive spent ion exchange resins in plastics. Moriyama, N.; Dojiri, S.; Emura, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment); Sugo, T.; Machi, S. *J. Nucl. Sci. Technol. (Tokyo);* **12**: No. 6, 362-369(Jun 1975).

Experiments were undertaken on the incorporation in plastics - polyethylene in particular - of radioactive spent ion exchange resins produced in nuclear power plants. The resulting polyethylene products burdened with radioactive resin were tested to ascertain the properties considered important for radioactive waste management. The items chosen for testing were mechanical strength, leachability of radionuclide and radiation resistance. Polyethylene products burdened with 50 wt % of resin were found to possess an impact strength of 10 kg.cm/cm and a compressive strength of 300 kg/cm^2, which values do not indicate any appreciable decrease in mechanical strength compared with polyethylene unburdened with resin. The leaching rate of ^{137}Cs from the resin-burdened polyethylene product was very small - only 0.1% leached out in one year. In respect of decomposition by radiation, the amount of gases evolving upon absorbing a dose of 10^8 rad was 10 ml/g. The effect of radiation on the mechanical strength was also studied. It is concluded from above results that solidification of radioactive spent ion exchange resin by incorporation in plastics is one of the best methods devised so far for treating spent resins.

25487 Removal of radioactive strontium from water by coagulation-flocculation with ferric hydroxide. Bull, P.S.; Evans, J.V.; Knight, R.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Chemical Technology Div.). *J. Appl. Chem. Biotechnol.;* **25**: No. 11, 801-807(Nov 1975).

A systematic study of the removal of the radioactive fission product strontium from aqueous solution by ferric hydroxide flocs has shown that strontium can be removed effectively, in contrast to cesium which is poorly removed (<= 5%) under all conditions examined. Removal of strontium was enhanced by raising pH to a maximum of 10.5, increasing the iron/strontium ratio, or by adding phosphate ion, provided the phosphate/iron mole ratio did not exceed 0.33. In the absence of phosphate the optimum conditions for strontium removal, over the range of iron and strontium concentrations examined, were pH 10 and strontium/iron mole ratio 0.08. Addition of phosphate reduced the pH at which significant removal was obtained to about 8. The mechanism of removal has been identified as an ion-exchange reaction at the surface of the ferric hydroxide particles; consequently, when considering the process for the removal of strontium-90 from hard natural or process waters competitive effects from the larger concentrations of calcium and magnesium present in the water become important.

25488 Formation and trapping of radioactive aerosols and gases in nuclear fuel reprocessing and high-level radioactive waste treatment. Kepak, F.; Razga, J. *Jad. Energ.;* **22**: No. 3, 108-112(Mar 1976). (In Czech).

A review is presented of more than 90 studies focused on the sources of radioactive aerosols and gases, methods of aerosol trapping and their application, methods of gas trapping, methods of ruthenium and iodine separation. It is shown that the trapping of radioactive effluents is a complex problem which should be tackled together with the problems of the technological process involved. While radioactive gases and aerosols mostly result together, different methods must be used for their trapping. The methods discussed remove radioactive wastes with such efficiency that their release exceeding the permissible concentrations is precluded. The methods, however, will have to be further developed to match a significant increase in radioactive effluents as a result of the construction of fast reactors or reprocessing plants.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 25469, 25482, 26437, 26438

25489 (BNWL-B—442) Relative evaluation of structural integrity in candidate cask closures for the reference sealed storage cask design. Anderson, W.E.; England, R.L.; Friley, J.R.; Vagins, M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1975. Contract E(45-1)-1830. 76p. Dep. NTIS $5.00.

For Atlantic Richfield Hanford Co., Richland, WA.

Closure methods for sealing waste storage casks were investigated and a relative evaluation is made for four candidate cask closure concepts: a solid head butt joint, a multi-plate, a threaded plug/seal weld, and a solid heat/corner weld. The multi-plate concept was most susceptible to loss of structural integrity on a relative basis and thus least desirable of the closure concepts. The threaded plug/seal weld was less susceptible than the multi-plate. The solid head corner weld closure was somewhat better than the threaded plug/seal weld. The solid head butt weld closure was much better than the multi-plate concept, all on a relative comparison basis. (JRD)

25490 (TID—27088) Geology of the north end of the Salt Valley Anticline, Grand County, Utah. Gard, L.M. Jr. (Geological Survey, Denver, Colo. (USA)). 1976. Contract E(40-1)-4339. 39p. Dep. NTIS $4.00.

The geology and hydrology of a portion of the Salt Valley anticline lying north of Moab, Utah, that is being studied as a potential site for underground storage of nuclear waste in salt are discussed. Selection of this area was based on recommendations made in an earlier appraisal of the potential of Paradox basin salt deposits for such use. Salt Valley anticline, a northwest-trending diapiric structure, consists of Mesozoic sedimentary rocks arched over a thick core of salt of the Paradox Member of the Middle Pennsylvanian Hermosa Formation. Salt began to migrate to form and/or develop this structure shortly after it was deposited, probably in response to faulting. This migration caused upwelling of the salt creating a linear positive area. This positive area, in turn, caused increased deposition of sediments in adjacent areas which further enhanced salt migration. Not until late Jurassic time had flowage of the salt slowed sufficiently to allow sediments of the Morrison and younger formations to be deposited across the salt welt. A thick cap of insoluble residue was formed on top of the salt diapir as a result of salt dissolution through time. The crest of the anticline is breached; it collapsed in two stages during the Tertiary Period. The first stage was graben collapse during the early Tertiary; the second stage occurred after Miocene regional uplift had caused downcutting streams to breach the salt core resulting in further collapse. The axis of the anticline is a narrow

generally flat-floored valley containing a few hills composed of downdropped Mesozoic rocks foundered in thecaprock. The caprock, which underlies thin alluvium in the valley, is composed of contorted gypsum, shale, sandstone, and limestone—the insoluble residue of the Paradox salt.

25491 Release pathways for deep seabed disposal of radioactive wastes. Anderson, D.R.; Bishop, W.P.; Bowen, V.T.; Brannen, J.P.; Caudle, W.N.; Detry, R.J.; Ewart, T.E.; Hayes, D.E.; Heath, G.R.; Hessler, R.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). pp 483-502 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

Disposal of high-level solidified and encapsulated radioactive wastes into the deep sea floor has conceptual advantages in that the areas of the mid-plate/mid-gyre regions of the oceans are relatively unproductive biologically and relatively devoid of cataclysmic events, and natural processes there are generally quite slow. Given a lack of singular events, a set of barriers against the dispersion of the radioisotopes may be defined. The inverse of these barriers is the set of mechanisms by which the isotopes are transported from the burial site through the barriers to parts of the ocean of immediate significance to mankind. These include: corrosion of the cask; leaching of the waste material; upward transport of the isotopes with the upward moving pore water (mediated by ion-exchange processes); biological transport through bioturbition in the upper sediment layers and lowest water layer; the slow throughput currents of the deep basins; advection and diffusion through the water column; thermally driven transport through the sediments or the water column; biological transport of incorporated isotopes across the seabed or upward through the water column. In principle, the rates of all these processes are measurable or capable of being estimated. Such estimates are given on the basis of present knowledge of the processes in the deep basins. A methodology is discussed for the analytical treatment of the set of processes to give the amount of the isotopes reaching some part of the environment (e.g., and oceanic regime of immediate significance to man) as a function of time. It is concluded that disposal in the deep seabed is conceptually attractive because of the stability and predictablity of the environment, but that it is not possible to give a firm estimate of the safety of such a scheme from the current knowledge of the mid-plate/mid-gyre regions.

25492 Analysis of criteria for determining the extent of permissible radioactive waste disposal from nuclear power stations into river systems. Pisarev, V.V.; Tsybizov, I.S. (AN SSSR, Moscow. Inst. Prikladnoj Geofiziki). pp 431-440 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; International Atomic Energy Agency (1975). (In Russian)

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The economic advantages of siting nuclear power stations close to rivers are given by the fact that use can then be made of a very cheap direct-flow cooling system and by the possibility of disposal of radioactive wastes. However, if advantage is to be taken of these opportunities, waste disposal from the nuclear power station must be strictly regulated (subject to standards) in order to ensure the radiation safety of the population using the river and the territory adjacent to it in one way or another. A similar problem arises if a nuclear power station is regarded as a potential radiation risk in view of the possible accidental entry of radioactivity into the river waters. The maximum permissible disposal of liquid radioactive waste into river systems must be determined on the basis of the specific physicogeographical conditions, account being taken of the use made of the river and of the river valley and also of social and economic factors affecting the population groups critically involved. Estimates of the maximum permissible discharge of liquid radioactive wastes into rivers in specific cases have to be made in terms of quantitative characteristics or criteria suitable for practical use. This paper considers three groups of such criteria: hydrological, ecological and radiological.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 25475, 26461, 26547, 26562, 26650

25493 (KY-L—831) **Fluoride and nitrogen oxide removal from fuel cycle operations.** Pulley, H. (Paducah Gaseous Diffusion Plant, Ky. (USA)). 1976. Contract W-7405-eng-26. 31p. (CONF-760806—1). Dep. NTIS $4.00.

From Meeting on controlling airborne effluents from fuel cycle plants; Sun Valley, Idaho, United States of America (USA) (5 Aug 1976).

Emission of F^- and NO/sub x/ during the various steps of the fuel cycle is discussed. Methods for removing fluorides, fluorine, and NO/sub x/ are reviewed. 57 references. (DLC)

25494 (PB—241247) **Environmental surveys of the uranium mill tailings pile and surrounding areas, Salt Lake City, Utah. Final report.** Duncan, D.L.; Eadie, G.G. (Environmental Protection Agency, Las Vegas, Nev. (USA). Office of Radiation Programs). Aug 1974. 131p. (EPA—520/6-74-006). NTIS $5.75.

Environmental surveys have been conducted for the Utah State Division of Health's Occupational and Radiological Health Section at the former Vitro Corporation uranium mill and in the Salt Lake City, Utah, area. The surveys included measurement of external gamma radiation and airborne radioactivity. The results of the surveys indicated that: the external gamma radiation levels on the tailings area exceed recommended exposure limits. Ambient levels of radon over the pile and in structures built immediately adjacent to the tailings pile are above the currently recommended concentration. Tailings material has been removed from the Vitro site by persons and used around dwellings and businesses; and tailings material has become windborne and deposited against dwellings and structures in the vicinity. (GRA)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 25460

25495 (BARC/I—346) **Beta activity of enriched uranium.** Nambiar, P.P.V.J.; Ramachandran, V. (Bhabha Atomic Research Centre, Bombay (India)). 1975. 16p. INIS.

4 figs., 7 tables.

Use of enriched uranium as reactor fuel necessitates its handling in various forms. For purposes of planning and organising radiation protection measures in enriched uranium handling facilities, it is necessary to have a basic knowledge of the radiation status of enriched uranium systems. The theoretical variations in beta activity and energy with U^{235} enrichment are presented. Depletion is considered separately. Beta activity build up is also studied for two specific enrichments, in respect of which experimental values for specific alpha activity are available.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

25496 (BNWL-SA—5836) **Control of sampling errors.** Brouns, R.J.; Roberts, F.P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1976. Contract AT(45-1)-1830. 20p. (CONF-760615—7). Dep. NTIS $3.50.

From 17. annual meeting of the institute of nuclear materials management; Seattle, Washington, United States of America (USA) (23 Jun 1976).

Sources of error in sampling, sampling procedures, and monitoring and controlling sampling error are considered. (LK)

25497 (INIS-mf—2070) **International handling of fissionable material.** (Utrikesdepartementet, Stockholm (Sweden)). 1975. 33p. (In Swedish). (Ds-UD—1975-1). INIS.

The opinion of the ministry for foreign affairs on international handling of fissionable materials is given. As an introduction a survey is given of the possibilities to produce nuclear weapons from materials used in or produced by power reactors. Principles for international control of fissionable materials are given. International agreements against proliferation of nuclear weapons are surveyed and methods to improve them are proposed.

25498 (UCID—17166) **Executive summary of the special safeguards study on material control and accounting systems. Final report.** (California Univ., Livermore (USA). Lawrence Livermore Lab.; Science Applications, Inc., La Jolla, Calif. (USA)). 15 Sep 1975. 40p. Dep. NTIS $4.00.

This report assesses the feasibility of real-time systems applied to mixed-oxide fuel rod fabrication. Their interaction with other material control and accounting measures are considered. Economics, effectiveness, and acceptance factors are discussed. A cost-benefit evaluation is made and recommendations given for safeguards improvements. (DLC)

25499 Efficiency of material accountability verification procedures: A case study. Vol. I. Avenhaus, R. (International Inst. for Applied Systems Analysis, Laxenburg, Austria). pp 581-594 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

In the model agreement INFCIRC/153 the international nuclear materials safeguards system has been established such that the material accountability principle is the main safeguards tool, with containment and surveillance as complementary measures. In addition, it has been agreed that the plant operator generates all data necessary for the material balance establishment and reports them to the safeguards authority and furthermore, that these data are verified by representatives of the safeguards authority with the help of independent measurements. In this paper, the problem of the determination of the efficiency of the combined system - data verification and material balance establishment - is analysed. Here, the difficulty arises that the two statistical procedures used are not independent because part of the operator's data are used in both cases. It is the purpose of this paper to work out the procedure for calculating the systems efficiency, i.e. the overall guaranteed probability of detection for the whole system for an assumed diversion and a given false alarm rate as a function of the safeguards effort spent over a given interval of time. Simplified formulae are derived which allow for a quick determination of the whole system efficiency: it is shown that the correlation between the two parts of the total system can be neglected. Therefore, the total systems efficiency can be represented as the product of the efficiencies of the two subsystems. The method developed is applied to a concrete case of a chemical reprocessing plant for irradiated fuels on the basis of data collected earlier.

ADMINISTRATIVE AND REGULATORY

25500 Features and requirements of the United States nuclear material control system. Vol. I. Page, R.G. (Nuclear Regulatory Commission, Washington, D.C. (USA)). pp 37-56 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

The Nuclear Regulatory Commission (NRC) is responsible for regulating commercial activities in the United States of America associated with the processing, transporting, handling, and use of nuclear materials. As part of these responsibilities, the NRC has developed a domestic safeguards programme, which includes accountability and physical security measures, to protect against, deter, and detect the theft or diversion of nuclear material to unauthorized use, and to protect nuclear facilities against industrial sabotage. The safeguards programme is implemented through published regulations, and by licensing the possession and use of nuclear material. Accounting and internal material control measures are employed to monitor, control, and record nuclear material activities within plants, and to provide capabilities for detecting theft or unauthorized diversion of such material. The material control and accounting programme includes specific organizational requirements, measurement and statistical controls, storage and internal handling controls, periodic inventories, and a record and report system. To protect plutonium and high enriched material against theft and dispersion or utilization in illicit weapons, and to protect material, vital equipment and facilities against sabotage, a comprehensive physical protection programme is required.

25501 German Democratic Republic State system of accounting for and control of nuclear material. Vol. I. Roehnsch, W.; Gegusch, M. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). pp 71-82 of In Safeguarding nuclear materials. Proceedings of a symposium organized by the IAEA and held in Vienna, 20-24 October 1975. Vienna; IAEA (1976).

From Symposium on the safeguarding of nuclear materials; Vienna, Austria (20 Oct 1975).

The system of accountancy for and control of nuclear material in the German Democratic Republic (GDR) with its legal bases and components is embedded in the overall State system of protection in the peaceful uses of nuclear energy. As the competent State authority, the Nuclear Safety and Radiation Protection Board of the GDR is also responsible for meeting the GDR's national and international tasks in the control of nuclear material. At enterprise level, the observance of all safety regulations for nuclear material, including the regulations for the control, is within the responsibility of managers of establishments, which are in any way concerned with the handling of nuclear material. To support managers and to function as internal control authorities, nuclear material officers have been appointed in these establishments. Design information, operating data, physical inventory of nuclear material and the respective enterprise records and reports are subject to State control by the Nuclear Material Inspectorate of the Nuclear Safety and Radiation Protection Board. This Inspectorate keeps the central records on nuclear material, forwards reports and information to, and maintains the necessary contacts with, the IAEA. For the nuclear material in the GDR four material balance areas have been established for control purposes. To rationalize central recording and reporting, electronic data processing is increasingly made use of. In a year-long national and international control of nuclear material, the State control system has stood the test and successfully co-operates with the IAEA.

FUSION FUELS

REFER ALSO TO CITATION(S) 25924

PROCESSING

REFER ALSO TO CITATION(S) 26208

25502 Removal of tritium from neutron-irradiated lithium oxide. Kudo, H.; Tanaka, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). *Radiochem. Radioanal. Lett.*; **23**: No. 2, 57-62(1975).

2 figs.; 5 refs.; 1 table.

When neutron irradiated Li_2O was heated to 600degC under vacuum, tritium was mostly removed from the target material. More than 96% of tritium was found in a cold trap cooled at -72degC. The tritiated species predominated in the trap was assumed to be tritium oxide or tritiated water, although it has not been identified yet. In 0.8-3.5% of gaseous species were observed tritiated-hydrogen (H_2-T) and -methane (CH_4-T). The results obtained here suggested it favourable to use Li_2O as a tritium breeding material for a fusion reactor. Materials were irradiated in the JRR-4 reactor at reactor temperature approximately 50degC for 20 min. The thermal and fast neutron fluxes at the irradiation position were, respectively, approximately $3x10^{13}$ and approximately $4x10^{12}$n $cm^{-2}s^{-1}$.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 25447, 26222

25503 Gas centrifuge purge method. Theurich, G.R. (to Energy Research and Development Administration). US Patent 3,946,942. 30 Mar 1976. Filed date 12 Jul 1963. 8p.

PAT-APPL-294,774.

A method of separating isotopes in a high speed gas centrifuge is presented. A vertically oriented cylindrical rotor bowl is adapted to rotate about its axis within an evacuated chamber, and an annular molecular pump having an intake end and a discharge end encircles the uppermost portion of the rotor bowl. The molecular pump is attached along its periphery in a leak-tight manner to the evacuated chamber. End cap closure means are affixed to the upper end of the rotor bowl, and a process gas withdrawal and insertion system enters the bowl through the end cap closure means. The evacuated chamber, molecular pump, and end cap define an upper zone at the discharge end of the molecular pump, and the evacuated chamber, molecular pump, and rotor bowl define a lower annular zone at the intake end of said molecular pump. The method for removing gases from the upper and lower zones during centrifuge operation with a minimum loss of process gas from the rotor bowl is described.

25504 Steady and unsteady state analysis of a simple gas centrifuge. Auvil, S.R.; Wilkinson, B.W. (Michigan State Univ., East Lansing). *AIChE (Am. Inst. Chem. Eng.) J.*; **22**: No. 3, 564-568(May 1976).

The operating theory of the gas centrifuge is developed under both steady and unsteady state behavior. It is shown that

countercurrent flow patterns in a gas centrifuge enhance the possible separation. The effect of self-diffusion of the gaseous mixtures is shown to be significant with low molecular weight gases but of less significance with heavy gases such as uranium isotopes. The time required to develop steady state pressure and concentration profiles is in the order of minutes, even with no net flow to and from the machine.

RADIATION SOURCES

DESIGN AND FABRICATION

REFER ALSO TO CITATION(S) 26347

25505 Irradiation plant having a common closure. Bosshard, E. (to Sulzer Brothers Ltd.). US Patent 3,965,359. 22 Jun 1976. Priority date 5 Sep 1973, Switzerland. 8p.

A plant that is particularly suitable for treating clarified sludge is described. The container for holding the radiation sources is provided with a circular upper end and is closed by a common closure member. This member is, in turn, clamped onto the container by a holder via a bayonet connection. A clamping tool is also provided to remove the holder and permit replacement of the radiation sources. This tool also enables the holder and closure member to be pre-stressed before removing the holder and after re-asssembly of the holder.

ISOTOPIC POWER SUPPLIES

25506 (SAND—76-0260) **Power supplies for space systems quality assurance by Sandia Laboratories.** Hannigan, R.L.; Harnar, R.R. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jul 1976. Contract AT(29-1)-789. 29p. Dep. NTIS $4.00.

The Sandia Laboratories' participation in Quality Assurance programs for Radioisotopic Thermoelectric Generators which have been used in space systems over the past 10 years is summarized. Basic elements of this QA program are briefly described and recognition of assistance from other Sandia organizations is included. Descriptions of the various systems for which Sandia has had the QA responsibility are presented, including SNAP 19 (Nimbus, Pioneer, Viking), SNAP 27 (Apollo), Transit, Multi-Hundred Watt (LES 8/9 and MJS), and a new program, High-Performance Generator Mod 3. The outlook for Sandia participation in RTG programs for the next several years is noted.

DESIGN AND FABRICATION

25507 (DPST—72-128-1) **^{238}Pu fuel form processes. Savannah River Laboratory monthly report, July—September 1972.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1972. Contract AT(07-2)-1. 14p. Dep. NTIS $3.50.

The report is the first of a series of monthly reports to summarize progress in the Savannah River Laboratory (SRL) ^{238}Pu Fuel Form Program and covers a three-month period during which most of the effort was devoted to familiarization of SRL personnel with the status of development programs at the Los Alamos Scientific Laboratory (LASL) and Mound Laboratory; subsequent reports will be issued monthly. The SRL program is designed to provide technical support for the transfer of ^{238}Pu fuel form fabrication operations from Mound Laboratory to a new facility to be built at the Savannah River Plant (SRP), and then to assist in sustaining the plant operations. The program includes: (1) demonstration of SRL-SRP's ability to adapt processes and techniques, currently in use at LASL and Mound, to production at SRP, thereby providing design information and the data upon which technical standards and operating procedures will be based; (2) technical support to assist plant startup, and to assure continuation of safe and efficient production of high quality fuel forms; and (3) development capability to accommodate changes in product and product specifications, to assist user agencies in improving product performance, and to assist the plant in developing process steps that increase efficiency and product reliability.

25508 (DPST—73-128-1) **^{238}Pu fuel form processes. Savannah River Laboratory monthly report.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jan 1973. Contract AT(07-2)-1. 22p. Dep. NTIS $3.50.

Details of the program at SRL in support of the Milliwatt RTG development were established at a meeting at Sandia Laboratories-Albuquerque. Emphasis will be on the characterization of the properties of oxalate-type $^{238}PuO_2$ made at SRP. Experimental quantities of direct-strike and high-purity $^{238}PuO_2$ will be provided for the compatibility program and the fabrication tests now in progress at Mound Laboratory. The smaller particle size of Plant-produced direct-strike PuO_2 (13 to 22 μm for Laboratory batches) probably results from differences in agitation during precipitation. Evaluation of available technical information indicates that direct recycle of reject PuO_2 components by crushing and milling to approximately 2-μm particles will be possible in the SRP PuO_2 fabrication facility for both PMC discs and PPO spheres, as presently made at LASL.

25509 (DPST—76-128-5) **^{238}Pu fuel form processes. Savannah River Laboratory monthly report.** (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). May 1976. Contract AT(07-2)-1. 23p. Dep. NTIS $3.50.

Progress in the Savannah River ^{238}Pu fuel form program is summarized. Suspended solids observed in the technical-grade oxalic acid solution used in H-Area B-Line had no significant effect on particle size or morphology. A small but significant increase in product purity was noted with the use of reagent-grade oxalic acid. The density of hot-pressed LCHP pellets made from both problem and standardized feed decreased with longer milling times as was observed for multi-hundred watt (MHW) pellets. The LCHP pellets (greater than 90 percent theoretical density) generally cracked following final heat treatment. Cold-pressing studies indicate the anticipated pressure variation during cold pressing in the PuFF facility will have negligible effect on the density of MHW spheres. Construction of the plutonium experimental facility is 72 percent complete.

25510 Process of safely compacting a radio-active material into a solid body. Van Nederveen, H.B. (to SKF Industrial Trading and Development Co., BV). US Patent 3,970,517. 20 Jul 1976. Priority date 15 Jan 1973, Netherlands. 4p.

A process for compacting a granular radioactive material into a sealed solid body for use as a heat source is described. The process is carried out in a hot-cell which is partially evacuated.

HYDROGEN

PRODUCTION

REFER ALSO TO CITATION(S) 25515, 26216, 26231

25511 Process for generating hydrogen gas. Beckert, W.F.; Dengel, O.H.; McKain, R.W. (to Secretary of the Navy). US Patent 3,931,395. 28 Jun 1974. Filed date 23 Feb 1973. vp.

A method is claimed for generating hydrogen gas by heating a composition comprising the intimate mixture in the solid state of at least one compound having the general formula (NH_4)/sub n/X where X is an inorganic acid group and n is the valency of said inorganic acid group and at least one compound having the general formula $Y(ZH_4)$/sub m/ where Y is a mono- or divalent metal capable of forming complex hydrides and is selected from the group consisting of alkali metals and alkaline earth metals, m is the valency of said mono- or divalent metal and Z is a trivalent metal capable of forming complex hydrides and is selected from the group consisting of boron and aluminium, wherein said compounds are present in about stoichiometric amounts or are present in amounts such that there is a stoichiometric excess of one of the components, to a temperature high enough that said $Y(ZH_4)$/sub m/ reacts with said (NH_4)/sub n/X to produce hydrogen gas.

THERMOCHEMICAL PROCESSES

25512 (UCID—17172) **Preliminary flow sheet and process design for ZnSe thermochemical cycle.** Otsuki, H.H.; Cox, K.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Jun 1976. Contract W-7405-Eng-48. 26p. Dep. NTIS $4.00.

A preliminary design of the ZnSe cycle for thermochemical hydrogen production has been prepared for use in deriving economic costs for hydrogen production. The process flowsheet identifies key equipment items as well as major streams. Flow and heat loads have been estimated based on one mole of hydrogen output. The thermal efficiency of this cycle depends on two factors: (1) the ability to perform the dissolution of $ZnSO_4$ and the hydrolysis of ZnSe with a minimum amount of aqueous HCl, and (2) the ability to match the process heat requirements with available heat from the exothermic steps in the cycle. Estimates of the cycle's thermal efficiency range from 34—57 percent depending upon the process heat utilization.

STEAM REFORMER PROCESSES

REFER ALSO TO CITATION(S) 25226

STEAM-IRON PROCESS

25513 (FE—1518-34) **Development of the steam—iron system for production of hydrogen for the HYGAS process. Quarterly report, July 1—September 30, 1975.** Tarman, P.; Punwani, D. (Institute of Gas Technology, Chicago, Ill. (USA)). 1975. Contract E(49-18)-1518. 40p. Dep. NTIS $4.00.

Design, procurement, and construction work on the steam—iron pilot facility continued. On an overall basis, about 96 percent of the engineering design work has been completed. About 48 percent of the field construction is finished. The data obtained earlier in Task A, Reducing-Gas Generation Tests, with Husky char, were analyzed to determine the extent of sulfur gasification and methane formation. The results indicate that the amount of sulfur in the product gas is higher than that predicted by the H_2 and H_2S equilibrium over Fe and FeS, and that the amount of methane formed is generally higher than that estimated by graphite—hydrogen—methane equilibrium. In Task D, Fluidized-Bed Tests, three types of attrition tests were conducted with siderite ore at a constant superficial velocity of 1.7 ft/s in a 2.5-in.-diam column. The results of these tests show that the rate of fines generation by attrition is (1) Inversely proportional to about the 0.6th power of the initial particle size. (2) Proportional to about the 4th power of the gas velocity through the orifice when fluidization velocity is proportionately decreased (constant total gas flow). (3) Proportional to about 1.7th power of the gas velocity through the orifice at constant fluidization velocity. The results indicate that increased fluidization around the orifice (more gas flow through the porous plate) decreases attrition rates. Work on Tasks F and G (kinetic studies and char evaluation, respectively) was begun in July 1975. (LK)

STORAGE

REFER ALSO TO CITATION(S) 26156

CHEMISORPTION

25514 (BNL—21322) **Hydrogen storage and purification systems III.** Reilly, J.J.; Wiswall, R.H. (Brookhaven National Lab., Upton, N.Y. (USA)). 1 Mar 1976. Contract E(30-1)-16. 38p. Dep. NTIS $4.00.

Pressure-temperature composition relationships are presented for a number of alloy—hydrogen systems. These include a series of Mg—Al alloys; intermetallic compounds of Mg with Ba and with Ce; several ternary Mg alloys; alloys of Ti with Fe, with Co and with Cr; and several ternary Ti alloys.

TRANSPORT

25515 **Hydrogen as an energy vector.** Powers, W.D. (National Aeronautics and Space Administration, Huntsville, AL). pp 627-632 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

The feasibility of using hydrogen as an energy vector is considered with major emphasis upon hydrogen production processes. A survey of existing state-of-the-art is presented, along with some estimates of the technical difficulties that must be overcome before hydrogen can be widely used as an energy carrier.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 25515

PROPERTIES

REFER ALSO TO CITATION(S) 25523

OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 25556, 25557, 25945

25516 **Municipal solid waste as a resource for energy recovery and conservation.** Alter, H. (National Center for Resource Recovery, Inc., Washington, DC). pp 59-75 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The energy potential of the waste stream generated in 1971 (the last year for which reliable statistics are available) and 1974 (by extrapolation) are analyzed, including energy conservation available from materials recovery. The analysis is then extended to the immediate future based on several likely conversion and substitution efficiencies and on likely rates of implementation of new resource recovery plants. (JSR)

HYDROCARBON FUELS

REFER ALSO TO CITATION(S) 25199, 25226, 25246, 25291, 25538, 25554, 25555

25517 (BM-TPR—25) **Conversion of urban refuse to oil.** Appell, H.R.; Wender, I.; Miller, R.D. (Bureau of Mines, Pittsburgh, Pa. (USA). Energy Research Center). May 1970. 7p. Bureau of Mines, Pittsburgh, PA.

Urban refuse, cellulosic wastes, and sewage sludge have been converted to heavy oil by heating under pressure with carbon monoxide and steam. Conversions of the organic matter to oil, water, and gas have averaged near 90 percent at temperatures of 250° to 400°C and pressures of 1,500 to 5,000 psi. The yield of oil, based on the dry organic matter of the waste materials, is usually near 40 percent. This is the equivalent of more than 2 barrels of oil per ton of dry, ash-free waste material. The oil from urban refuse and cellulosic wastes has a sulfur content near 0.1 percent. This low sulfur content makes the oil from refuse a desirable source of fuel oil.

25518 (FE—1773-18) **Development studies on conversion of methanol and related oxygenates to gasoline. Quarterly progress report No. 4, November 1975—January 1976.** Voltz, S.E.; Wise, J.J. (Mobil Research and Development Corp., Paulsboro, N.J. (USA)). Mar 1976. Contract E(49-18)-1773. 101p. Dep. NTIS $5.50.

Five cycles of a long-term aging test in the fixed bed pilot plant have been successfully completed. The total on-stream time is over 100 days. In addition, catalyst performance is still very good. This test is being conducted at a higher recycle ratio, lower conversion reactor temperature, and lower space velocity than employed in the previous aging test. The lower steam partial pressure (resulting from higher recycle ratio) and lower reactor temperature reduce catalyst deactivation due to steaming. The milder operating conditions of the current aging test have substantially improved gasoline stability. Additive concentrations of 5 lb metal deactivator plus 15 lb antioxidant per 1000 bbl have inhibited gum formation in potential gum tests to low and acceptable levels even beyond methanol breakthrough. Lower concentrations of 1 lb metal deactivator plus 2.5 lb antioxidant per 1000 bbl also provided adequate protection until near methanol breakthrough. The temperature profiles in the catalyst bed during the aging test have revealed a well-defined reaction band in which there is a sharp temperature rise. The reaction band moves through the catalyst bed during each cycle. The kinetic model for methanol conversion, which was originally developed for the fluid bed reactor, has been extended to the fixed bed reactor. The results have provided an estimate of the ratio of the conversion efficiencies of the two different types of reactors. The relative efficiencies are comparable to those observed for other processes. The feasibility of operating with durene recycle has been experimentally demonstrated in a fixed bed pilot plant (single reactor). The results indicate that durene production can be reduced by this type of operation. Also, durene recycle has no apparent deleterious effects on catalyst performance (cycle length) or product yields.

25519 **165th national meeting of the American Chemical society, Dallas, Texas, April 8—12, 1973. Volume 18, No. 1.** Struck, R.T.; Schora, F.C. Jr. Ann Arbor, MI; Xerox University Microfilms (1976). 276p. (CONF-730403—P1). $4.00.

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

Papers from symposia on fuel from wastes and coal gasification are compiled. Separate abstracts were prepared. (JSR)

25520 **Gasification of organic waste.** Cox, J.L.; Hoffman, E.J.; Hoffman, R.W.; Willson, W.G.; Roberts, J.A.; Stinson, D.L. (Univ. of Wyoming, Laramie). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **18**: No. 1, 1-14(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

A process for the conversion of solid organic waste into synthetic natural gas is described. The conversion has been carried out in a one-stage, multiple-catalyst coal gasification unit which is currently under investigation at the University of Wyoming under the Sponsorship of the Department of the Interior, Office of Coal Research. Bench-scale studies have shown the chemical feasibility of the conversion which involves the reaction of steam with the solid organic waste. Over 900 Btu/MSCF (CO_2-free) gas, composed predominantly of methane, has been produced from a variety of reactant materials. The yields of gaseous products were 80-90 percent of the theoretical values. These yields and gas compositions are discussed in regard to the reactants and operational variables of temperature, pressure, and catalyst.

25521 Hydrogasification of cattle manure to pipeline gas. Kiang, K.D.; Feldmann, H.F.; Yavorsky, P.M. (Bureau of Mines, Pittsburgh). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 1, 15-23(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

Results of batch studies are presented that establish that manures are readily convertible to synthetic natural gas, SNG, by the direct reaction with hydrogen. Yields of methane, ethane, carbon monoxide, and carbon dioxide, carbon conversions, and hydrogen consumption and their dependency on the hydrogen/waste feed ratio and reaction temperature are reported for dried cattle manure. With dried cattle manure, it was found possible to produce acceptable SNG after simply scrubbing out the CO_2 thus eliminating the methanation step required for other SNG processes which use coal, oil or naphtha as feed stocks.

25522 Synthesis of hydrocarbons by the high intensity arc. Sheer, C.; Korman, S. (Columbia Univ., New York). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 1, 71-100(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

The use of a convective high intensity arc for the production of hydrocarbons has been studied on a laboratory scale. Use is made of the capability of a novel type of electrode, termed the fluid convection cathode (FCC), in conjunction with a carbon anode, to generate a profusion of high-temperature carbon-hydrogen species. The systems studied included carbon + hydrogen, carbon +a CO-H_2 mixture, carbon +steam, and carbon + a solid (CH_2)/sub x/ entrained in argon. It was possible to demonstrate a spectrum of parametric variations whereby the product contains hydrocarbon consisting of pure methane or pure acetylene. A catalytic surface effect on the arc effluent composition was also observed. This involved wall temperature, contact surface composition, and residence time. By variation of the feed into the FCC, the change in plasma composition and the downstream catalysis appear to be interrelated. For example, low flow rates of H in CO-H_2 or in steam favor enhanced production of methane, whereas under the same conditions, the same amount of H as pure hydrogen produced only a minor amount of acetylene or no hydrocarbon. The results to date lend support to the belief that the FCC arc may be applied to the gasification of coal and other feedstocks.

25523 Reaction of atomic hydrogen with carbon. Snelson, A. (IIT Research Inst., Chicago). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 1, 101-134(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P1.

A metal and glass reactor was used to study low-pressure atomic hydrogen and carbon reactions. Atomic hydrogen produced thermally was allowed to impinge on a temperature-controlled carbon target in the temperature range 30-950°C. Unreacted hydrogen and organic reaction products were isolated on a liquid helium cold finger placed close to the carbon target and were subsequently analyzed both quantitatively and qualitatively by gas chromatography. Over the temperature range examined the major organic reaction product was CH_4 approximately equal to 90 percent, together with smaller amounts of C_2H_6 approximately equal to 9 percent and C_3H_8 approximately equal to 1 percent. No unsaturated hydrocarbons were detected. Contrary to the results of previous studies on the reaction, the formation of hydrocarbons did not reach a maximum at about 550°C, but showed a continuous increase with temperature. The methane yield temperature dependence showed three distinct phases and activation energies were obtained. Upper and lower limits of 17 percent and 0.6 percent were determined for the room temperature conversion of atomic hydrogen to methane at the carbon target. At 950°C these values were threefold larger.

25524 Conversion of bovine manure to oil. Fu, Y.C.; Metlin, S.J.; Illig, E.G.; Wender, I. (Bureau of Mines, Pittsburgh). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **17**: No. 1, 37-43(1976).

From 164th National American Chemical Society meeting; New York, New York, United States of America (USA) (27 Aug 1972).

See CONF-720821—P1.

The conversion of bovine manure to oil was studied in a 1-liter stainless steel autoclave using a feed ratio of water:manure of 4:1 and an initial CO pressure of 600 psi. The organic matter in bovine manure is almost completely converted by the reaction with carbon monoxide and water at 380°C and 4800 psi, and yields 40 weight percent oil; water, water-soluble organic compounds, and gaseous products are also formed. The residue is inorganic, mostly silica. Both conversion and oil yield increase with temperature in the 300 to 380°C range. The carbon monoxide consumption correlates well with the oil yield, and is in the range of 0.7 to 0.8 gram/gram manure at the best conversion. Use of hydrogen in place of carbon monoxide decreases the conversion and oil yield. Synthesis gas (approximately equal amounts of hydrogen and carbon monoxide) gives almost complete conversion and slightly lower oil yield than pure carbon monoxide, but a significant improvement can be attained by the use of a shift conversion catalyst. The carbon monoxide consumption is also reduced significantly when synthesis gas is used. In the presence of an alkylnaphthalene-based oil vehicle, good conversion has been achieved with the water:manure ratio of as low as 1:4.

25525 Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Conference held at Orlando, Florida, January 27—30, 1976. Chicago; Institute of Gas Technology (1976). 152p. (CONF-760132—). $40.00.

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

Separate abstracts were prepared for ERA and EPA of the 24 papers presented. (JSR)

25526 Wastes and biomass as energy resources: an overview. Klass, D.L. (Inst. of Gas Tech., Chicago). pp 21-58 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The national economy can be maintained on organic fuels by converting major sources of continuously renewable nonfossil carbon to synfuels that are interchangeable with, or can be substituted for, natural gas and petroleum-derived fuels. Promising sources of this carbon are waste materials, such as urban refuse, and biomass produced from solar energy by photosynthesis. The overview of the development of this concept presented in this paper points out the broad scope of the technology and its potential impact on U. S. energy supplies. The renewable feature of both wastes and biomass makes them valuable "natural resources" that inevitably will be fully developed and commercialized as sources of energy-intensive products and synfuels. The perpetual availability of organic fuels will permit the conservation of our valuable fossil-fuel reserves, and, as time passes, offer a long-term solution to independence from foreign energy supplies and fossil-fuel depletion.

25527 Resource recovery and flash pyrolysis of municipal refuse. Preston, G.T. (Occidental Research Corp., La Verne, CA). pp 89-114 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The Occidental Resource Recovery System is designed to be a low-pollution, low-net-cost technique for disposal of municipal refuse and recovery of its valuable energy and mineral constituents. Ferrous metals, clean glass cullet and an aluminum rich non-ferrous fraction are recovered as readily marketable commodities. The proprietary FLASH PYROLYSIS process converts the organic portion of the refuse into about 1 barrel of low sulfur liquid fuel from each ton of raw refuse. The pyrolysis reactor operates at modest temperature and pressure and uses no catalyst, hydrogen, oxygen, or supplemental fuel. The pyrolytic oil product has been shown by independent tests to be usable as a substitute for No. 6 residual (Bunker C) fuel oil in a steam-generating boiler furnace. The complete process will be demonstrated at a 200-ton-per-day plant now under construction in San Diego County, California.

Other applications of the Occidental technology include production of a solid fuel from municipal refuse, pyrolysis of industrial organic wastes such as tree bark, and gasification or organic wastes by FLASH PYROLYSIS.

25528 Fuel gas and electricity from municipal sewage. Bargman, R.D.; Betz, J.M. pp 115-121 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

A gas containing 65 percent methane and 35 percent carbon dioxide can be produced in a sewage treatment plant by an established process. The gas can be utilized in internal combustion engines to produce power in quantities sufficient in many cases to sustain the plant's processes. The quantity of gas produced is small in comparison to the fuel needs of the community served by the treatment facility. The City of Los Angeles has operated for the past 25 years a 140,000 KWH/day diesel engine power plant utilizing gas produced at the Hyperion Treatment Plant. The gas provides 94 percent of the fuel requirements of the engines.

25529 SNG from refuse and sewage sludge by the BIOGAS process. Ghosh, S.; Klass, D.L. (Inst. of Gas Tech., Chicago). pp 123-181 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

Laboratory, small pilot, and field work on the development of a process for the gasification of municipal solid wastes and sewage sludge has had a number of objectives. These include increasing the production of methane and the solids destruction efficiency; cost reduction; evaluating, selecting, and integrating unit operations; and improving the overall process design. Out of this work has evolved BIOGAS, a family of process designs for disposal of combined refuse and sludge wastes and for the production of SNG and recyclable products. It is concluded that the next logical step in this program is to demonstrate the technology in a 100-ton/day plant to confirm the findings and to justify full-scale plant operations.

25530 Synthetic natural gas from animal wastes by anaerobic fermentation. Douglas, R.W. pp 183-196 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The development studies on an anaerobic digestion process for the production of methane with a purity of 98 percent or more from cattle manure are briefly summarized. Details of the process are not disclosed because patent application has been filed. (JSR)

25531 Fuel gas from landfill. Mandeville, R.T. (Reserve Synthetic Fuels, Inc., Newport Beach, CA). pp 197-204 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

Decomposing garbage has always produced certain gases, including methane, which have always been considered a liability. Today, the opportunity exists to turn this liability into an asset as a marketable fuel by proper extraction and processing of the gas. The world's first commercial landfill methane recovery facility at the Palos Verdes Landfill in southern California, operated by Reserve Synthetic Fuels, Inc., has demonstrated the viability of landfill methane recovery and has proven that the liability can become an asset. Landfill methane recovery potential can best be determined only through an extensive and sophisticated testing program on each individual landfill, and proper interpretation and evaluation of accumulated data. The recovered landfill gas can be utilized as low BTU gas as a source of fuel for steam or direct gas turbine power generation, direct sale of partially cleaned up low BTU gas to industrial customers, or conversion of refuse gas to pipeline standard fuel for injection into the nearby utility company pipeline, which is considered to be the most economically sound alternative.

25532 Conversion of grass to fuel gas for captive use. Klass, D.L.; Ghosh, S.; Conrad, J.R. (Inst. of Gas Tech., Chicago). pp 229-252 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The concept of using raw materials from or around the home to generate its fuel needs in the form of fuel gas from small-scale units is presented. A preliminary assessment of the conversion of common lawn grass to fuel gas has been performed. Lawn grass, consisting predominately of Kentucky Bluegrass grown in northern Illinois, was converted in laboratory digesters to intermediate-Btu gas by batch and semicontinuous anaerobic digestion techniques. The experimental results were used to propose possible system designs for use by the homeowner. Even though the technical feasibility of the concept presented in this paper is supported by the experimental data, the cost, the management, and the reliability of such systems are major factors that affect their practical value. A large amount of additional research and detailed engineering design are needed to make the conversion of grass to fuel gas a realistic fuel supply source for captive use.

25533 Conversion of ocean farm kelp to methane and other products. Leese, T.M. (Naval Weapons Center, China Lake, CA). pp 253-266 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

This paper is a description of the process being studied under the Ocean Farm Project at the Naval Undersea Center (NUC) for the conversion of kelp (Macrocystis pyrifera—giant California kelp) into fuels. The objective of the project is to provide a viable, renewable-source alternative to the use of fossil fuels as they become less plentiful and more expensive. The current major priority of the conversion process effort is to convert the organic material in kelp to methane and utilize the resulting by-products and waste as: (1) terrestrial fertilizer, (2) feed supplements for meat-producing animals, and (3) miscellaneous industrial products. A brief description of the Ocean Farm concept that will produce the kelp biomass and a discussion of the kelp composition and major potential products will also be covered to give perspective to the process description.

25534 Economic assessment of fuelgas from water hyacinths. Lecuyer, R.P.; Marten, J.H. pp 267-286 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

An economic study is presented to produce 200 million scf/day of methane using water hyacinths as a feedstock. The water hyacinths are grown in a controlled area, harvested by a unique process and converted to a 600 Btu/scf biogas through an anaerobic digestion process. The biogas is then upgraded to methane by removal of carbon dioxide gas from the biogas using the Benfield process. The approximate 1000 Btu/scf Pipeline Quality Gas (PQG) is then compressed to pipeline pressure and sold to a gas pipeline company or large industrial user(s). Water hyacinths were selected as a feedstock because of their prolific growth rate (60 dry tons/acre/year), absence of a current economic value, and ease of harvesting since they are floating plants. The results of the analysis indicate that the process is ecologically sound, technically feasible, and economically near-viable in an increasing natural gas cost economy, but possibly questionable from a public acceptance standpoint because of the large land area required. However, alternatives to any biomass-to-fuel concept include nuclear energy and strip mining of large coal reserves both of which are meeting with some public resistance. Alternatives to oil and natural gas energy-based economies must be developed since these energy resources will be depleted within 50 years at the most.

25535 EPA's program in environmental research in wastes-as-fuel. Huffman, G.L. (U.S. Environmental Protection Agency, Cincinnati). pp 397-412 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

Major waste-as-fuel technologies and methods are being pursued by EPA to determine their environmental and energy

benefits, and to develop technology to control undesirable environmental impacts. The potential energy benefits associated with adoption of waste-as-fuel technologies are significant. EPA has had a very significant R and D program in wastes-as-fuel since 1967 under authorities of the 1965 Solid Waste Disposal Act and the Resource Recovery Act of 1970. The current EPA research program in wastes-as-fuel has 4 major areas of emphasis: (1) assessment R and D (environmental, technical, economic); (2) municipal waste co-firing with coal, oil, or industrial waste; (3) municipal waste co-combustion with sewage sludge; and (4) pyrolysis and bioconversion processes. Current program emphasis is on the municipal solid-waste stream since it represents a significant environmental control problem. Industrial and agricultural waste disposal problems will be scrutinized to determine whether waste-as-fuel technologies should be applied there as well.

25536 PUROX System. Fisher, T.F.; Kasbohm, M.L.; Rivero, J.R. (Union Carbide Corp., Tonawanda, NY). pp 447-459 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The PUROX system for the conversion of solid wastes to fuel gas and inert slag by a partial oxidation process is described. The intermediate-Btu gas produced can be used either for combustion in power plants or as a synthesis gas for making such chemicals as methanol and ammonia. (JSR)

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 25518, 25525, 25526, 26011, 26033

25537 Enzymatic hydrolysis of cellulosic wastes to fermentable sugars for alcohol production. Spano, L.A. (U.S. Army Natick Development Center, MA). pp 325-348 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The research and development of an enzymatic process for the conversion of cellulosic wastes to a glucose syrup which can then be used for the production of single-cell protein, alcohol, or other fermentation products is described. The major areas of research needed to make the technology economically feasible are outlined. Economic evaluations of the present technology indicate that alcohol production is economically unfeasible; conversion to sugars for use as chemical feedstocks is presently feasible; production of single-cell protein is attractive and should be actively pursued. (JSR)

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 25525, 25526, 25535, 25554, 25994, 25995, 26358, 26359

25538 (N—75-20830) **Energy recovery from solid waste. Volume 1. Summary report. Final report.** (Houston Univ., Tex. (USA)). Apr 1975. Contract NGT-44-005-114. 30p. (NASA-CR—2525; S—442(Vol.1)). NTIS $3.75.

A systems analysis of energy recovery from solid waste which demonstrates the feasibility of several processes for converting solid waste to an energy form is presented. The social, legal, environmental, and political factors are considered and recommendations made in regard to legislation and policy. A technical and economic evaluation of available and developing energy-recovery processes is given with emphasis on thermal decomposition and biodegradation. A pyrolysis process is suggested. The use of prepared solid waste as a fuel supplemental to coal is considered to be the most economic process for recovery of energy from solid waste. Markets are discussed with suggestions for improving market conditions and for developing market stability. A decision procedure is given to aid a community in deciding on its options in dealing with solid waste. (Author) (GRA)

25539 Baltimore demonstrates gas pyrolysis. Sussman, D.B. Washington, DC; US Solid Waste Management Office (1974). 28p.

A look at Baltimore's new solid waste facility is presented. The system is designed to recover energy in the form of steam by converting solid waste into a combustible gas by pyrolysis and then use the gas as a fuel to fire a steam boiler. The objective is to demonstrate the technical and economical feasibility of energy recovery from mixed municipal waste by pyrolysis and to evaluate the marketing of steam, ferrous metals, glassy aggregate, and carbon char. Detailed information is provided on the project's benefits, design aspects, products, economics, and environmental impact.

25540 Forests as a source of electric power. Beardsley, W.H. (Green Mountain Power Corp., Burlington, VT). pp 349-358 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

Forests have resource characteristics which are both renewable and nonrenewable in nature. As such, they offer a unique opportunity as a source of energy. As an energy reserve the supply is significant. As a renewable energy source, surplus annual production is significant. In addition, wood is a clean fuel, it appears competitive with fossil fuels, capital costs are reasonable, and technology for converting wood to steam and electricity is proven and operational. Wood also displays a positive energy balance. The inventory of our timber reserves and annual growth based on energy content is considerably larger than conventional forest inventories. New harvesting technology makes it possible to harvest and transport the heretofore unmerchantable treetops, branches, irregular stems and unwanted species. Skyrocketing fossil-fuel prices have suddenly made wood fuel competitive for power generation in Vermont and possibly elsewhere. As an interim solution, wood offers this country a means of buying energy time and deserves consideration.

25541 Environmental studies on the St. Louis-Union Electric refuse firing demonstration. Kilgroe, J.D. (U.S. Environmental Protection Agency, Research Triangle Park, NC); Shannon, L.J.; Gorman, P. pp 413-426 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The U. S. Environmental Protection Agency, the City of St. Louis, and the Union Electric Company are demonstrating the use of shredded municipal solid waste (MSW) as a supplementary fuel in a pulverized-coal-firing utility boiler. The Midwest Research Institute (MRI), under EPA direction, is experimentally evaluating this demonstration. The partial results of tests to characterize pollutant emissions and energy recovery at the refuse processing and firing facilities are presented. Processing-plant noise levels and dust emissions have been evaluated. Noise levels greater than those permitted by OSHA for continuous worker exposure are exceeded at eight equipment locations in the plant. Dust emitted from the processing operations contains significant amounts of bacteria and viruses. Further characterization of these microbiological organisms is needed to assess potential health problems that may exist. The combustion of RFD as a supplementary fuel in the Union Electric pulverized-coal-fired boiler: may result in moderately increased Cl^- emissions; does not significantly affect SO_x or NO/sub x/ emissions; reduces the collection efficiency of the ESP at loads above 100 MW, primarily because of higher gas flow volumes; increases the boiler residue by a factor of 4 to 7; and increases the water pollution levels for 16 to 64 pollutants evaluated. From 68 to 80 percent of the available higher-heating value of the refuse received at the processing plant is converted to usable energy in the Union Electric boilers.

HYDRO ENERGY

PLANT DESIGN AND OPERATION

25542 Hydro-electric generation of power from small bodies of water. Riem, G. US Patent 3,970,859. 20 Jul 1976. Filed date 9 Jan 1975. 6p.

The following specification discloses a means of converting a head of water from a lake into electric power by directing a flow of water onto a turbine disposed in a crib built below the floor of the lake and having intermittent exploding gas means to create a vacuum for drawing the fallen water from below the turbine back into the lake.

SOLAR ENERGY

REFER ALSO TO CITATION(S) 25987, 25988, 25989, 26916

25543 (SAN/1122—76/1) **Description of the solar energy R and D programs in many nations. Final report.** de Winter, F.; de Winter, J.W. (eds.). (Atlas Corp., Santa Clara, Calif. (USA)). Feb 1976. Contract E(04-3)-1122. 298p. Dep. NTIS $9.25.

The present report includes descriptions of the Solar Energy R and D Programs of 32 countries, of the Organization of American States, of UNESCO, and of a number of private organizations. The descriptions were solicited from the most reliable representatives known for the individual countries, and were received between late July 1975 and February 1976.

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 25645

25544 (CONF-751181—, pp 8p, Paper 3) **Solar energy in the '70's.** Yellott, J.I. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

Attempts to make technological use of solar radiation have occurred in a remarkably regular cycle, starting in the late 1860's and continuing through the decade from 1870 to 1880. Similar attempts have continued in approximately two-decade intervals up to the present time. The motivation force for the pioneers of a century ago was the need for engines that could drive water pumps. Today's greatly accelerated activity in all aspects of solar energy utilization arose from the belated recognition that the world's fossil fuel supply is finite in quantity and that nuclear fission provides only a stop-gap, since the supply of fissionable uranium is also finite. With the entrance of hundreds of new contenders into the solar energy field, there is also a trend towards re-inventing the wheel, since most of the newcomers are unaware of the fact that, with the exception of the silicon solar cell and selective surfaces for collectors, most of today's heliotechnology was tested extensively a century ago. The purpose of this paper is to present a brief summary of the major accomplishments of the pioneers who have worked diligently but with little reward or recognition for their attempts to harness the endless flow of radiant energy from our nearest star, the sun. (from Introduction)

25545 **Solar energy recorder.** Lollar, R.B.; Mandt, R.R. (International Business Machines Corp., Huntsville, AL). pp 77-88 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A serious obstacle to the large-scale terrestrial application of solar energy in today's "energy crisis" lies in the scarcity of reliable data on the amount of solar energy at candidate converter sites. This paper describes a system designed to monitor and record, automatically, the values of the direct and total (sun and sky) solar radiation which would be seen by either tracking or fixed type solar converters. A further pressing need addressed by the system is the means for efficiency testing and evaluation of solar cells, solar collectors, and solar concentrator systems, under outdoor exposure to natural sunlight and weather conditions for extended periods. The design was accomplished in support of the Marshall Space Flight Center, NASA, where design concepts and materials for large-scale terrestrial solar energy converters are currently being evaluated.

HEAT STORAGE AND REJECTION

REFER ALSO TO CITATION(S) 25575, 25577, 25578, 25616, 25636, 25638

ECONOMICS

REFER ALSO TO CITATION(S) 25633

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 25545, 25610

25546 (CONF-751181—, pp 13p, Paper 11) **Solar photovoltaic cells.** Backus, C. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

Topics discussed include photovoltaic principles, cell fabrication, silicon solar cells, cadmium sulfide solar cells, gallium arsenide solar cells, and photovoltaic systems with concentration. (WDM)

25547 **Air Force sponsored photovoltaic research.** Green, J.M. (Wright-Patterson Air Force Base, OH). pp 615-625 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A process called electrostatic bonding is being developed to apply glass covers to solar cells by an electrochemical reaction which would eliminate the present tedious task of adhesively bonding covers to each cell by hand. This process can reduce the cost of covering from $2.50 to $0.25 per cover. A new type of solar cell which has 1000 vertical junctions per centimeter instead of the conventional single junction parallel to the surface is under development. This device, called a vertical multijunction solar cell, has enhanced long wavelength response which makes it attractive for earth-based systems and vastly improved radiation resistance which would be necessary for space-based systems. Lightweight solar array research was pioneered by the Air Force Flexible Rolled-Up Solar Array Program. This array used a flexible substrate which can be rolled up compactly onto a cylindrical drum to save both weight and volume in the satellite system.

25548 **Performance of diffused vertical multijunction solar cell.** Sodha, M.S.; Agarwal, A.K. (Indian Inst. of Tech., New Delhi). *Sol. Energy;* **18**: No. 3, 265-268(1976).

From the behavior of the conversion efficiency of vertical multijunction diffused solar cell, it is concluded that efficiency is largely dependent on the built-in-field. This built-in-field, in turn, is a function of the equilibrium carrier concentration profile which is governed by the diffusion technique and can be controlled easily to obtain optimum results.

25549 **Epitaxial silicon solar cells.** D'Aiello, R.V.; Robinson, P.H.; Kressel, H. (RCA Laboratories, Princeton, New Jersey 08540). *Appl. Phys. Lett.;* **28**: No. 4, 231-234(15 Feb 1976).

Several $p^+/p/n/n^+$ epitaxial silicon solar-cell structures were fabricated with the n-base region intentionally graded over 2 orders of magnitude in a thickness of 35 μm. Solar cells made from these layers exhibited near-ideal I-V characteristics in the practical operating range, with an open-circuit voltage of 636 mV, fill factor of 0.79, and AM1 efficiency of 12.6%. A similar epitaxial structure containing no gradient in the n-base showed good solar-cell performance but lower open-circuit voltage (603 mV). (AIP)

25550 **Thin metal films as applied to Schottky solar cells: optical studies.** Anderson, W.A.; Delahoy, A.E.; Milano, R.A. (Rutgers-the State Univ., New Brunswick, NJ). *Appl. Opt.;* **15**: No. 6, 1621-1625(Jun 1976).

Thin metal films (approximately 100 A) have been studied for application to Schottky barrier solar cells (SBSC). Metal films having greater than 55 percent transmission over the solar spectrum and resistance of 20 Ω/square have been applied to Si to form a rectifying contact. A 9.5 percent sunlight efficient SBSC was produced using 50-A Cr adjacent to the Si for good adhesion and high open circuit voltage and a 50-A Cu overlayer to produce low sheet resistance. Film quality has been related to evaporation rate, metal layer selection, and substrate conditions. Solar cell performance is determined by the transmission and resistance of the thin metal films. Spectral response data show the SBSC to exhibit improved short wavelength sensitivity compared to the p-n Si solar cell.

25551 **Method of planar mounting of silicon solar cells.** Leinkram, C.Z.; Oaks, W.D.; Eisele, J.A.; Faraday, B.J. (to Secretary of the Navy). US Patent 3,964,155. 22 Jun 1976. Filed date 8 Jun 1973. 4p.

A method is described for mounting silicon solar cells in a planar array that not only yields electrical insulation between cells

but allows for a multifold increase in thermal dissipation of the cell array, comprising metallizing a wafer of beryllium oxide on each side so that the outer surface is copper, etching the wafer on one side so that the only metallized parts which remain are those on which the solar cells are to be mounted or wiring is to be attached, soldering the solar cells on the unetched copper prominences, coating the aluminium panel on which the cells are mounted with a copper layer, soldering the underside of the wafer on the upper surface of the aluminum panel with soft solder such as indium, and covering all remainging passive surfaces with a teflon F.E.P. tape the underside of which carries a layer of silver and then a layer of inconel metal.

25552 Solar cell grid patterns. Yasui, R.K.; Berman, P.A. (to National Aeronautics and Space Administration). US Patent 3,966,499. 29 Jun 1976. Filed date 19 Apr 1974. 8p.

A grid pattern for a solar cell of the type including a semiconductive layer doped to a first polarity and a top counter-doped layer. The grid pattern comprises a plurality of concentric conductive grids of selected geometric shapes which are centered about the center of the exposed active surface of the counter-doped layer. Connected to the grids is one or more conductors which extend to the cell's periphery. For the pattern area, the grids and conductors are arranged in the pattern to minimize the maximum distance which any injected majority carriers have to travel to reach any of the grids or conductors. The pattern has a multiaxes symmetry with respect to the cell center to minimize the maximum temperature differentials between points on the cell surface and to provide a more uniform temperature distribution across the cell face.

PHOTOSYNTHETIC CONVERSION

REFER ALSO TO CITATION(S) 25525, 25533, 25534, 25540, 26011

25553 Mechanism and efficiency of photosynthesis in green plants. Bassham, J.A. (Univ. of California, Berkeley). pp 205-228 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

On the basis of a simplistic diagram of photosynthesis, a broad picture is sketched of the mechanisms of photosynthesis. The efficiency of the photosynthetic process and areas of research needed to improve this efficiency are indicated. (JSR)

25554 Energy from agriculture. Alich, J.A. Jr.; Inman, R.E. (Stanford Research Inst., Menlo Park, CA). pp 287-309 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The Project Independence task force in their final Project Independence blueprint report projected that, under the accelerated implementation plan, bioconversion might provide as much as 8 percent of our energy requirements in the year 2000. They further speculated that under this scenario bioconversion will be the single most important solar energy concept. Under bioconversion four sources of biomass are included: urban solid waste, agricultural residues, and energy crops both terrestrial and marine. In this paper terrestrial energy crops are emphasized, other schemes are only commented on briefly. The types of vegetation best suited for an intensive energy plantation as well as vegetation selection criteria are discussed. The type and availability of land for, as well as logistics and economics of, growing energy crops on a conceptual terrestrial plantation are also discussed. An energy budget for plant material production and harvesting for the conceptual plantation is developed. A techno-economic comparison of firing the crops directly for electric power generation with converting them to clean fuel gas (methane or low-Btu gas) either at the farm site or at selected markets is made.

25555 Gas production from micro algae. Oswald, W.J. (Univ. of California, Berkeley). pp 311-324 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

Micro algae are able to fix solar energy in the visible spectrum with daily production of 10 to 20 grams of cell material per square meter. The heat of combustion of these algae is about 5.5 kilogram calories per gram, and 50 to 70 percent of this energy can be converted to methane through anaerobic fermentation of the algae. On the basis of existing technology, it appears plausible to utilize large ponds for initial fixation of energy and for transformation of the energy to methane. Most promising is an integrated solid waste and algal bio-gas facility in which combustion of dry wastes could be used to generate power, release CO_2 for algae and heat the digesters. Under these circumstances an area of about 68 million hectare would meet the gaseous energy needs of the United States in the year 2000. The energy would have a net cost of more than $2 per million Btu but it would be environmentally clean, pollution free and eternally available. Crucial research needs are to seek improved photosynthetic efficiency, improved species and species control, more economical methods of harvesting algae and a method of integrating nutrients for continuous algal growth.

25556 Design, operation, and economics of the energy plantation. Fraser, M.D.; Henry, J.F.; Vail, C.W. (InterTechnology Corp., Warrenton, VA). pp 371-395 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

An Energy Plantation is a means for producing fuels by collecting and storing solar radiation in plants grown purposely for their fuel value. Appropriate selection of plant species and plantation cultural practices is the key to producing fuels from Energy Plantations at attractive cost. The Energy Plantation is designed and operated for maximum productivity of plant material at an attractive cost. A mathematical model was developed for predicting the average annual sustained yield. The manpower and equipment requirements were investigated. Operations considered in detail include production of clones, planting, weed control, cultivation, harvesting, transporting materials, spreading residues from the fuel-using operation, and maintaining equipment. Costs for plantation operation are estimated. For large-scale plantations, the estimated capital cost for establishing the plantation is about $11-$12 per annual oven-dry ton of capacity for deciduous species, and $8-$9 for warm-season grasses. The cost of fuel produced is estimated to be about $14-$15 per oven-dry ton for deciduous material and $13-$14 for warm-season grass material. These fuel costs translate into energy costs of less than $1.20 per million Btu of useful heating value, as fired.

25557 Federal fuels from biomass energy program. Ward, R.F. pp 427-436 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

This paper presents a brief overview of the Federal research and development activities in the field of Fuels from Biomass and includes abstracts of the individual projects that comprise the program.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 25617, 25661

25558 (CONF-751181—, pp 16p, Paper 7) **Large scale heliolectric systems.** Blake, F. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

Technology required for development of a solar energy conversion power plant yielding in excess of 17 watts per square foot of collector area in terrestrial installations in the southwestern U.S. is available. A straightforward hardware development program directed at economic optimization and augumentation-type applications into systems with existing storage is warranted to demonstrate that solar power has near-term potential as an alternative power source. Key features of the candidate system are: central receiver energy conversion; tower mounting of central receiver; multiple solar collector fields; single-central power generation station; concentrating heliostats of laminated glass mirrors; and southward sloping site.

25559 (CONF-751181—, pp 17p, Paper 16) **Community integrated energy systems.** Meinel, A.; Meinel, M. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

The architecture of Saudi Arabia is briefly discussed. Topics discussed under solar applications include: community application; public attitude; community power; power tower; spherical collectors; economics; efficiency; central plants; house heating; and utility management. (WDM)

25560 (ERDA/NASA/19740—76/1) **Technical feasibility study of modular dish solar electric systems.** Gupta, B.P.; Buchholz, R.L.; McBride, E.M.; Gray, D.C.; Bohan, W.M. (Honeywell, Inc., Minneapolis, Minn. (USA); Black and Veatch Consulting Engineers, Kansas City, Mo. (USA)). Mar 1976. Contract NAS 3-19740. 182p. (NASA-CR—135012). Dep. NTIS $7.50.

The effort was directed at establishing the technical feasibility of modular generation of electricity through the use of dish collectors, and thereby eliminating the heat transport problem of distributed solar collector systems. The superior optical performance of dish collectors among the modular collector concepts led to its selection for detailed analysis in the power generation range of 30 to 100 kW(t) per module. Effort was also directed at the central receiver concept to examine the benefit of smaller mirror size for power generation in the range of 500 kW to 4 MW(t). On the basis of the results of the optical and thermodynamic analyses performed during this program, a paraboloid of revolution dish with a cavity receiver using an open air regenerative Brayton Cycle turbine emerged as the most promising concept in the power range from 30 to 100 kW(t) per module. (WDM)

25561 (SAND—76-5291) **Economic study of solar total energy.** Harrigan, R.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 15p. (CONF-760821—1). Dep. NTIS $3.50.

From Sharing the sun, solar technology in the seventies; Winnipeg, Canada (15 Aug 1976).

This paper investigates the application of solar total energy to a 2000-dwelling-unit mixed-load community. The community design is consistent with current community planning practices. An energy analysis of the community was performed, and a solar total energy system sized to meet the community demands. The economics of providing a solar total energy system is examined. The effect of dwelling-unit density is examined.

25562 Simulation model for solar thermal electric power systems. Johnson, G.R.; El Gabalawi, N. (Colorado State Univ., Fort Collins). pp 553-572 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A simulation model for the dynamic performance analysis of solar thermal electric power plant concepts was developed and is in use at Colorado State University. The paper presents a brief description of the overall program structure, the subsystem modules used to model each of the components, the control algorithm used to model each of the components, the control algorithm used to control the operation of the entire electric power plant and presents results for a distributed solar thermal electric power plant configuration. This power plant consists of 1912, 6.9 meter diameter Fresnel reflectors. The configuration is 52 rows of 33 collectors mounted serially in each row with the turbine generator occupying the center of the rectangular configuration. Steam generation takes place in cavity absorbers mounted one above each Fresnel reflector. Thermal storage is accomplished using steam accumulators. The plant is rated at 12 megawatts. The operation of this plant was simulated for an entire year in Albuquerque, New Mexico, using weather service data of 1959 and 1962. In addition, the same plant was simulated in Inyokern, California, using the data of 1962; and El Paso, Texas, using data of 1962. Results include a typical days operation in spring, winter, and summer. Also presented are the monthly power production and histograms of the daily output for each site. Preliminary estimates of the costs per kilowatt-hour production are also indicated.

25563 Solar insolation transients: their impact on the design and testing of solar thermal power plants. Lindley, C.A. (Aerospace Corp., Los Angeles). pp 573-590 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

The passage of cloud shadows over the collector mirror field of a solar thermal power plant may impose severe thermal transients on certain components of the power plant. The most vulnerable components are expected to be the tubes of the receiver-boiler, the steam turbine, the steam downpipe, and the power plant control system. The preferred solutions will vary with the power plant configuration and will require careful attention in the detailed design to the impact of transients. But these transients will not impose a strong leverage on the choice of power plant configuration. The development testing of a given design must be carefully planned to prove the proper handling of the transient problem.

25564 Minimum-cost solar collector fields. Duff, W.S. (Colorado State Univ., Fort Collins). pp 591-604 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

In the approach used in this paper minimum cost fields are sequentially built up for various values of useful thermal power as measured by the fluid mass flow rate and temperatures in and out of the field. The optimum piping arrangements, field geometries, mixes of collector types, pipe diameters and insulation thicknesses are determined for each minimum cost field. Examples of the application of the optimization approach are presented for fields producing hot water and steam.

25565 Solar thermal electric power systems. Duff, W.S.; Karaki, S. (Colorado State Univ., Fort Collins). pp 605-614 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

This paper summarizes a recently completed eighteen-month NSF/RANN study on solar thermal electric power systems. The methodology used in the study to find minimum-cost systems is indicated and pertinent results are presented. A bibliography of articles and presentations resulting from this study is also included.

25566 Solar electrical generating system. Dix, S. US Patent 3,965,683. 29 Jun 1976. Filed date 9 May 1974. 6p.

A lens is used to concentrate solar rays to heat an expansible fluid. Energy is extracted from the fluid to drive an electric current generator. The heated fluid may first pass through a heat sink to provide a more continuous flow of heated fluid to the current generating system. The lens itself may be biconvex and comprise two or more plates. If desired, the volume between the plates may be filled with a fluid, preferably having the same index of refraction as the material of the plates. Suitable apparatus may be provided to control the azimuth and bearing of the lens so that it is always situated as nearly as possible between the sun and the fluid container.

ORBITAL POWER PLANTS

25567 Activities in space-based solar power development. Whitacre, W.E. (National Aeronautics and Space Administration, Huntsville, AL). pp 31-41 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

This paper discusses advanced space-based power conversion and delivery systems based on concepts which have in common the characteristic that the power generation and delivery systems are located in geosynchronous orbit converting solar energy to electrical energy and transmitting it to a ground station. NASA's role in studying these concepts is described as it covers the technical and economic aspects of these rather bold proposals. Main emphasis is currently being placed on economic comparisons between the various space concepts and ground-based conventional and evolutionary solar power generation systems. The space systems are presently envisioned in sizes up to 10,000 MW(e) each and are conceived as being operational before the turn of the century. The apparent advantages are the high operating efficiency of these systems in space, and the avoidance of many forms of pollution common to ground systems. The primary problem areas common to all of them are space transportation, in space assembly of very large structures, logistics and maintenance, and predicted lifetime, and the associated capital investments required.

TOWER FOCUS POWER PLANTS

25568 Tower reflector for solar power plant. Rabl, A. (Argonne National Lab., IL). *Sol. Energy;* **18**: No. 3, 269-271(1976).

A method is proposed for transfering the energy from the top of the tower to the power plant at the bottom of the tower by

using a reflector. Preliminary estimates appear favorable, and it is recommended that a detailed systems analysis be performed comparing the tower reflector with the power tower. (WDM)

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 25991, 25992

25569 (APL/JHU/AEO—75-37) **Analytical study of two-phase-flow heat exchangers for OTEC Systems.** Olsen, H.L.; Pandolfini, P.P. (Johns Hopkins Univ., Laurel, Md. (USA). Applied Physics Lab.). 1 Jul 1975. 133p. Dep. NTIS $6.00.

The work began in July 1975. Prior in-house research at the Laboratory had spanned two years and had yielded a preliminary design for a low-cost OTEC plant—ship intended for operation in tropical oceans for producing ammonia or other energy-intensive products. Because the heat exchanger concept represented an extrapolation from existing experience, a comprehensive analytical study followed by an essentially full-scale experiment with the basic heat exchanger elements is needed. The analytical study reported herein is believed to meet the first requirement, and a plan for the experiment is included. (WDM)

25570 (BNWL-SA—5808) **Ocean thermal energy conversion opportunities.** Perrigo, L.D.; Jensen, G.A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1976. Contract E(45-1)-1830. 31p. (CONF-760549—1). Dep. NTIS $4.00.

From Symposium on energy alternatives; Richland, Washington, United States of America (USA) (15 May 1976).

Ocean Thermal Energy Conversion is one of several different concepts for use of solar energy. Recent estimates suggest about 4 percent of our nation's energy needs in 2020 might be supplied by successful use of this concept which involves the operation of a heat engine on the temperature difference between surface and deeper ocean waters in the tropics. However, to achieve the base load power potential of this process a substantial research and development effort is needed in the next few decades. Major improvements are required for control of biofouling and corrosion and improved heat transfer systems. The thermodynamic efficiencies of this process are very low and methods for preventing film deposits are mandatory. Heat transfer cannot realistically be improved by increasing pump rates or heat transfer surfaces because of intolerable parasitic power demands or capital expenditures. The development and use of OTEC power plants also has political implications that must be accommodated. Operation of such systems must be reconciled with various international agreements, the needs of marine navigation, and national defense requirements.

25571 (ORO—4918-8) **Economic evaluation of mixture and pure fluid cycles in ocean thermal energy conversion systems.** Lawson, C.A. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). 30 Apr 1976. Contract E(40-1)-4918. 144p. Dep. NTIS $6.00.

Thesis.

The OTEC3-1 simulator is capable of calculating the capital cost of major equipment in an Ocean Thermal Energy Conversion power plant. The results of this research study indicate that the heat exchangers are the principal contributors to the capital cost of the ocean thermal power plant. The sensitivity analysis performed in this research study showed that there are several economic trade-offs associated with the design and performance of the heat exchangers. The trade-offs include such items as the cold water pipe length, the sea water temperature rise and velocity. It was observed that mixtures provide an increasing economic advantage over pure fluids as the temperature rise in the cold sea water is increased. It is postulated that significant economic savings can be experienced with the use of mixtures if the cost of the heat exchanger can be reduced by one-half their present cost.

25572 (PB—242167) **An evaluation of oceanographic and socio-economic aspects of a nearshore ocean thermal energy conversion pilot plant in subtropical Hawaiian waters. Final report, 1 May 1974—31 Jul 1975.** Bathen, K.H. (Hawaii Univ., Honolulu (USA). Dept. of Ocean Engineering). 30 Apr 1975. 312p. (NSF/RANN/SE/AER—74-17521-A01/FR/75/2). NTIS $9.25.

Ocean thermal energy conversion (OTEC) proof-of-concept/pilot plant studies in subtropical waters are discussed. The three-part socio-economic program was concerned with examining the legal aspects of a nearshore OTEC plant. The applicable law, federal interests, licenses and permits, opposing interests, legislative experience, and site considerations were considered. An attempt was made to characterize the existing socio-economic conditions in the Kona (Keahole) area by examining the social infrastructure, local population, labor force, income and education, Konal electrical demand, and potential impact of a new power source. An input-output analysis for the Kona area was completed to model and further predict the impact of a new energy source on the economy of Hawaii County.

SOLAR RADIATION UTILIZATION

SPACE HEATING AND AIR CONDITIONING

REFER ALSO TO CITATION(S) 25559, 25561, 25643, 25654, 25656, 25659, 25669, 25675, 25990, 25991, 26001

25573 (CONF-751181—) **Proceedings of the ASC/AIA Forum '75 solar architecture, Tempe, Arizona, November 26—29, 1975.** Franta, G. (ed.). (Arizona State Univ., Tempe (USA). Coll. of Architecture). 1975. 327p. Dep. NTIS $10.00.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

Separate abstracts were prepared for the sixteen papers presented. All of these abstracts will appear in ERDA Energy Research Abstracts (ERA), and eleven are included in Energy Abstracts for Policy Analysis (EAPA). (LMT)

25574 (CONF-751181—, pp 18p, Paper 2) **Introduction to solar architecture.** Cook, J. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

A general discussion is presented on solar architecture in terms of history, energy response, solar building fundamentals, solar collectors, architectural applications, and thermal storage. A criticism of typical 20th Century architecture concludes the presentation—citing in particular, the Lever House, New York and Gund Hall, which houses Harvard's Graduate School of Design, as examples of three-dimensional consumption machines. (WDM)

25575 (CONF-751181—, pp 13p, Paper 6) **Passive solar architecture.** Haggard, K. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

A very ancient tradition of passive solar architecture with roots reaching back into prehistory and into diverse cultures is flowering once again in the Southwest. The coincidence of exceptionally high solar availability in a region of substantial thermal demand provides a great impetus to this growth during a period of increasing concern about the finite nature and deleterious environmental impact of the accelerating use of fossil fuels. With appropriate siting, orientation, design geometry and careful use of largely indigenous material, many structures are being built today which can provide a comfortable human environment having a minimum auxiliary input at a moderate price.

25576 (CONF-751181—, pp 7p, Paper 8) **Planning and landscape energy design.** Larson, G. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

Generally very basic, natural landscape materials and common sense techniques combined in good, sound, energy-conscious design of exterior spaces should be encouraged. A conscious effort needs to be made to re-educate the public in the benefits derived from the use of landscape elements. Not only do trees, shrubs and ground covers provide beauty and stimulation to our senses, they also provide numerous objectively evaluated and quantified functions, namely: (1) control sound; (2) curtail erosion; (3) block wind; and (4) lessen the effect of solar radiation. (Introduction, modified)

25577 (CONF-751181—, pp 10p, Paper 9) **Skytherm heating and cooling process.** Hay, H. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

First, the philosophy and reality of passive thermal control systems are presented. Afterwards, the passively heated and cooled house at Atascadero, California is described briefly. (WDM)

25578 (CONF-751181—, pp 43p, Paper 12) **Energy-conserving folk architecture in rural New Mexico.** van Dresser, P. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

It is proposed that a building program be implemented in the Southwest using native materials such a stone, adobe, and rough-sawn timber. Appendices cover the following topics: in situ measurement of adobe "U" factor; thermal transmission through an adobe wall; demonstration/test dormitory modules for proposed manpower training project; sandwellings house design proposal (level site convective rock storage); flat plate downslope collector, rock storage, with auxiliary skylights; sun tempered with roof flow collection, suntempered dwelling unit; a small dwelling; and experimental moderate-cost Sundwelling. (WDM)

25579 (CONF-751181—, pp 7p, Paper 14) **Commercial and governmental implications.** Fields, R. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

A brief discussion is presented on the programs of ERDA, HUD, and NASA in the solar space conditioning area. (WDM)

25580 (CONF-751181—, pp 7p, Paper 15) **Architectural response to energy and resource development (1975—2000).** Ingraham, E.W. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

A brief look is taken at the future directions that architecture may take. Some of the results from a small survey taken among architects across the country are presented and analyzed; the largest number of returns in the poll came from the 80 percent solar radiation zone, which includes mid-California, Colorado Front Range, and the southern states. (WDM)

25581 (CONF-751181—, pp 14p, Paper 17) **Solar heating and cooling of commercial and institutional buildings.** Bridgers, F. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

Three projects for possible application of solar heating and cooling were studied from an economic standpoint. The three projects were the Community College of Denver (North Campus), the University of Colorado Events and Conference Center (Basketball Arena), and the State of New Mexico Department of Agriculture Building at Las Cruces. It was concluded that larger buildings authorized for air conditioning have the best chance of justifying solar heating. (WDM)

25582 (COO—2560-1) **Solar energy heat pump systems for heating and cooling buildings, University Park, Pennsylvania, June 12—14, 1975.** Gilman, S.F. (ed.). (Pennsylvania State Univ., University Park (USA)). 1975. 246p. (CONF-7506130—). Dep. NTIS $8.00.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

Among the purposes and objectives of the workshop were the desire to bring people together, to present status reports, to describe and discuss recent designs and applications of solar heat pump systems, and to present equipment and systems performance characteristics. Separate abstracts were prepared for the individual papers. (WDM)

25583 (COO—2560-1, pp 5-12) **Heat pumps: what they are and what they do.** Gilman, S.F. (Pennsylvania State Univ., University Park). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

Conventional refrigeration compressor systems with constant speed electric motor drives are discussed. Emphasis is on reciprocating compressor systems as they are the most widely used, but some mention is made of centrifugal compressor systems. (WDM)

25584 (COO—2560-1, pp 13-20) **Solar assisted heat pump evaluation.** Cohen, A.D. (General Electric Co., King of Prussia, PA). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

An analysis was performed to evaluate the technical and economic feasibility of using solar energy for heating and cooling of buildings within a time frame of 25 years—from now until AD 2000. Performance estimates were generated for nine climatic regions within the United States on a matrix of six building types. This paper addresses the solar assisted heat pump application. By hourly computer simulation, information was derived to determine the amount of electric energy required to supplement solar energy over an entire heating and/or cooling season. By coupling this information with projected electricity costs through the year 2000 and the capital and operating expenses of the solar equipment, a life cycle economic assessment was made for selected locations and building types. (WDM)

25585 (COO—2560-1, pp 21-28) **Solar augmented variable speed heat pump.** Cherne, J.M. (TRW Systems and Energy, Redondo Beach, CA); Noe, J.C. 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

TRW, in conjunction with AiResearch, has developed the concept of the solar augmented variable speed heat pump. This system produces a coefficient of performance of 8.0 instead of the conventional heat pump COP of 2.3 at water source temperatures of 100°F. Low water temperatures such as this are obtained with low cost solar collectors. Preliminary data indicate that, in a typical winter season in Chicago, the solar augmented heat pump could conserve $^2/_3$ the energy required by an oil furnace at only $^1/_3$ the operating cost. (WDM)

25586 (COO—2560-1, pp 29-35) **Heat pumps are good: solar assisted heat pumps are better.** Weinstein, A. (Westinghouse Electric Corp., Baltimore). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

This paper provides the rationale that underlies the recommendations for solar assisted heat pumps. The principal reasons fall within the categories: comfort requirements; performance; and energy conservation. (WDM)

25587 (COO—2560-1, pp 36-45) **Solar energy heat pump system for the alumni house and conference center, State University of New York at Albany.** Rittelmann, P.R. (Hill and Associates, Butler, PA); Bodette, R. 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

The building is currently under construction and the purpose of this paper is to present some of the basic design data, schematics of this system as designed, and anticipated performance characteristics and to illustrate the capabilities of the system for evaluating a variety of operational modes. (WDM)

25588 (COO—2560-1, pp 49-54) **Evaluation of the Alburquerque, New Mexico, solar building.** Gilman, S.F. (Pennsylvania State Univ., University Park). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

The overall objective of the program is to develop a System Design Manual for solar energy assisted heat pump systems that will be applicable to all geographical areas and all types of commercial or industrial buildings. To accomplish this, the major steps are: (1) determine actual performance by analyzing field-collected data; (2) correlate results with computer predicted performance; (3) develop and refine a computer model of the building and system; and (4) use the computer model to generate information for the System Design Manual. The principal elements of the system serving 4300 sq ft of single-story office space are the 750 sq ft of water-type solar collector, a 6000-gal underground water storage tank, one $7^1/_2$-ton water-to-water heat pump, and 5 small tonnage water-to-air heat pumps. The collector has single glazing, is tilted 60° from the horizontal, and faces due south. (WDM)

25589 (COO—2560-1, pp 55-62) **Performance of a residential solar assisted heat pump system.** Jardine, D.M. (Douglas Jardine, Inc., Colorado Springs). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

This paper describes the design philosophy and performance characteristics of an experimental residential solar assisted heat pump system. Sufficient information is presented to create an understanding of the heating load characteristics of the system, and the system's response to the load. Further, the goal of the system to provide heat energy for the house with a minimum of peak demand on the utility system is pointed out. The importance of a heat storage system in optimizing the operation of a heat pump during cold weather is developed. Coverage is given to the results achieved to date in an ongoing research project. Collector performance, storage system characteristics, and heat pump performance along with demand on the utility system are key elements. (WDM)

25590 (COO—2560-1, pp 63-70) **Commerical and institutional building solar heat pump systems.** Drucker, E.E. (Syracuse Univ., NY). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

A detailed parametric study of solar assisted closed loop heat pump systems for heating moderate sized commercial and institutional buildings was conducted. The simulation is based on the use of commercially available water-to-air heat pumps in the 2- to 5-ton range, manufactured by about eight different American manufacturers, and single glazed copper flat-plate collectors. Performance computations were made for two buildings in each of three cities: Alexandria, Minneapolis, and Boston. One building was a 73,500 sq ft elementary school, modeled after the Tyler School in Alexandria, which is now equipped with a closed loop heat pump system. The second building was a five-story office building of 100,000 sq ft, also modeled after a typical existing structure. Economic analyses were carried out on the various systems to determine the relative return on the invested capital required to build the solar components. The effects of initial cost, interest rate, energy cost escalation rate, tax rate, and maintenance cost on the overall economic picture were studied.

25591 (COO—2560-1, pp 71-75) **Simulation of solar energy heat pump systems.** Freeman, T.L. (Univ. of Wisconsin, Madison). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

A general digital computer model of a vapor compression heat pump model is described. The basic concepts involved in the models of the individual components are reviewed and the steps in the modeling procedure are discussed. The modeling strategy is to first design or "size" the four major components in the cycle to yield a user-specified design condition performance. Then the program is able to calculate off design condition operating points. A "performance map" is constructed from repeated solutions for operating points throughout the heat pump's range, which can then be interpolated in a transient simulation, for operating points for any exchange fluid inlet conditions. A brief comparison is made of a heat pump boosted "in-line" solar system to a heat pump auxiliary "parallel" system.

25592 (COO—2560-1, pp 76-86) **Demonstration of a turbocompressor air conditioning system.** Biancardi, R.F. (United Technologies Research Center, East Hartford, CT); Meader, M.D. 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

During the past year a Rankine cycle turbocompressor heat pump program was conducted. The objectives of the program were to demonstrate efficient, simple, reliable operation of a laboratory system and to provide a basis for projecting ultimate system capabilities. The demonstration turbocompressor system is based on the adaptation of existing off-the-shelf key components and is capable of operating at temperature levels 160 to 220°F, consistent with present-day, flat plate solar collectors. The turbocompressor heat pump is a dual-loop system, utilizing a common fluid in a power loop and a refrigeration loop. Energy collected by the solar panel is used to drive the system. The system can be used for heating as well as cooling by suitable use of control valves and various component arrangements. The program was successful, with all the goals accomplished.

25593 (COO—2560-1, pp 87-97) **Solar heat pump featuring pivoting-tip vanes.** Fischer, R.D.; Frieling, D.H.; Talbert, S.G.; Eibling, J.A. (Battelle Columbus Labs., Columbus, OH). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

This paper reports progress in a feasibility study of a new concept of a solar-powered Rankine cycle vapor compression (RC-VC) heat pump. An alternative to absorption solar cooling systems is desirable for residential use. RC-VC systems are a good alternative because of potential reduction in size, cost, and maintenance as well as several other attractive features. Auxiliary power input to solar-powered RC-VC systems can be supplied by an electric motor, where absorption systems require heat. Still another advantage of RC-VC systems is that the Rankine power loop can be used to drive a generator to provide some of the homeowner's electric power demand during the spring and fall, when solar energy is more than sufficient to meet heating and cooling needs. (WDM)

25594 (COO—2560-1, pp 98-105) **Working fluids for solar Rankine heat pumps.** Allen, R.A.; Stiel, L.I. (Allied Chemical Corp., Buffalo). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

Considerable effort is presently being directed to the utilization of solar energy for the heating and cooling of buildings. Toward this goal, the properties of working fluids and their potential effect on the performance of a solar powered heat pump were investigated. In this study, the effect of the thermodynamic properties of the working fluid(s) on the performance of a solar powered heat pump system was analyzed. The system consists of a vapor compression cooling or heating cycle combined with a Rankine power cycle. Cycle and overall efficiencies were calculated for approximately 20 halocarbons and other substances. Values of the input fluid properties which result in optimum efficiencies were also determined for upper temperatures of 180 and 240°F. (WDM)

25595 (COO—2560-1, pp 109-118) **Solar-boosted super heat pumps.** Comly, J.B.; Jaster, H.; Quaile, J. (General Electric Co., Schenectady, NY). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

Solar assisted heat pumps are briefly reviewed in terms of efficiency, effect of temperature, efficiency of real heat pumps, heat pump capacity, super heat pump, parallel compression, cascade, series compression, turbocharging, two stage compression, modulated heat pump, solar space heating, and solar boosted heat pumps. (WDM)

25596 (COO—2560-1, pp 119-124) **Solar assisted cascaded heat pump concept.** Romancheck, R. (Pennsylvania Power and Light Co., Allentown). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

A cascaded solar heat pump system is briefly described and possible improvements to the system are mentioned. (WDM)

25597 (COO—2560-1, pp 125-131) **Solar augmented air-to-air heat pump installation.** Barkmann, H.G.; Yergensen, D.G. (Sunray Energy Corp., Denver). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

This paper describes briefly a residential heating installation consisting of an air-to-air heat pump, a sizable rock storage system, and a solar collector air heating system. The purpose of the solar augmentation to the heat pump is to provide a source of warm air for the outdoor section of the heat pump. The ability to store energy and provide warm air to the heat pump evaporator allows a

heat pump to operate at a much higher capacity and COP during periods of low outside air temperature. This scheme helps to overcome the main drawback of the normal heat pump where the capacity curve of the heat pump and demand curve of the load have opposite slopes as a function of temperature. A major part of the paper is devoted to a second generation system including the same components, and discussing design decisions based to some extent on lessons learned from the first system, and to a greater extent on new considerations. The advantages of such a system from the standpoint of reliability, economics, and minimal use of resource energy are indicated.

25598 (COO—2560-1, pp 132-139) **Comparison of heat pump systems for proposed library building, Idaho State University.** Bridgers, F.H.; Hopper, R.E. Jr. (Bridgers and Paxton Consulting Engineers Inc., Albuquerque, NM). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

The proposed Library Building of Idaho State University is a 180,000 ft² building having five levels, four of which are above grade and one below grade. The architects and engineers were instructed to design the most cost-effective energy-conserving system that would be practical for this building. There were three basic heat pump systems studied, all of which were compared to a conventional electric cooling and steam heating system which is referred to as the Conventional System: internal heat recovery heat pump system; well water heat pump system; and solar assisted heat pump system. (WDM)

25599 (COO—2560-1, pp 140-149) **Solar assisted heat pump installations in cold climates.** Dubin, F.S. (Dubin—Mindell—Bloome Associated, New York). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

It is concluded that the use of heat pumps with solar energy heating systems in the cold climate zones can be cost-effective. Several solar assisted heat pump systems are described. (WDM)

25600 (COO—2560-1, pp 150-155) **Heating and cooling system utilizing combined solar energy and internal heat sources.** Yu, H.C.; Hankins, R.P. Jr. (Hankins and Anderson, Inc., Richmond, VA). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

The heat recovery system in this building is of the low temperature, hot water type which utilizes the heat rejected by a centrifugal chiller to its condenser water for heating purposes within the building. This system has enough capacity, when recycling the internal building heat, to carry the skin load and the ventilation heating load of the building down to 20°F outdoor temperature. The solar energy system includes a 27,000 ft² collector on the roof which is designed to provide up to 125 tons of refrigeration through the medium of an absorption refrigeration machine. It is presently the largest known such system that has been attempted for providing the energy to both heat and cool a building. This system alone can carry the domestic hot water heating load, building heat loss, and ventilation heating load down to 45°F outdoor temperature.

25601 (COO—2560-1, pp 156-164) **Energy-use analysis and residential construction techniques.** Dirkse, D.J. (Bob Schmitt Homes, Inc., Strongsville, OH). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

This paper describes approaches to the development of an energy-efficient builder's house, with special emphasis on high insulation, low infiltration, and use of a nonsolar heat pump. (WDM)

25602 (COO—2560-1, pp 167-170) **Solar assisted heat pumps in a commercial building.** Prasad, J.N. (Syska and Hennessy, Inc., New York). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

This paper presents an outline of design of a solar assisted heat pump system in a commercial building. At present, the building is under construction in Washington, D.C., and it is expected to be operational by June 1976. The solar system consists of 2100 ft² of single-glazed, all-copper solar panels inclined at 63° from the horizontal, facing south, and a 4000-gal hot water storage tank. The HVAC systems consist of 245 water source heat pump units serving the perimeter areas and 19 packaged air conditioners for the interior spaces. The solar system is assisting the space heating through the heat pumps and preheating service water for the building. The cost analysis shows the net cost of the solar system is estimated at $25,000 and the payoff period about 12 years.

25603 (COO—2560-1, pp 171-175) **Extended range water source heat pumps.** Miller, J.F. (Singer Co., Auburn, NY). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

Whenever a combination of heating and cooling is required, and the heating and cooling loads vary from zone to zone, the closed loop heat pump system should be considered, not only for its true energy conservation characteristic, but for other advantages as well. (WDM)

25604 (COO—2560-1, pp 175-184) **Performance characteristics of air-to-air heat pumps.** Barnett, R.C. (General Electric Co., Louisville, KY). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

The data reflected in this report are calculated data intended to show relative comparisons of various heat pump configurations. The significant variations in actual field data resulting from variations in lifestyle can mask the relative performance differences. In addition, good test data for all configurations would be impractical to obtain. Calculated data are like a meter measuring relative values, and requiring field test data to calibrate the meter for accurate levels of performance. (WDM)

25605 (COO—2560-1, pp 185-190) **Solar heat pumps using water for cooling and heating.** Newton, A.B. 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

Commercial buildings frequently use circulating water for many of their heating and cooling functions. Chilled water is circulated at temperatures typically between 40 and 45F to zone air handlers or room units which usually have local control. For heating, warm water is circulated at some temperature above 110F to similar units which may each have separate controls. Most large buildings which use water for these cooling and heating functions employ water chillers equipped with centrifugal compressors. This paper deals with the use of such equipment in conjunction with solar systems which heat and cool buildings. (WDM)

25606 (COO—2560-1, pp 201-206) **Efficient stirling heat engine-heat pump.** Martini, W.R. (Univ. of Washington, Richland). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

The best way to use the available heat from solar collectors or from combustion is to employ a heat engine at the building site to produce energy near room temperature heat. The energy is then used in a heat pump operating between the building and a thermal reservoir. This paper shows what advantages there are to this approach to building heating and cooling if really efficient engines are used. The principle of the Stirling engine is explained. The requirements that must be met to attain a high efficiency Stirling engine and the requirements of a solar powered heat pump are reviewed. A simple but efficient free-displacer, free-piston heat pump is described. Computed performances of similar but earlier heat operated heat pump designs are presented and discussed along with key problem areas.

25607 (COO—2560-1, pp 209-212) **Residential solar assisted heat pump design.** Bansal, V. (Vosbeck, Vosbeck, Kendrick, Redinger, Alexandria, VA). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

Operating modes are described for a solar assisted heat pump system. The system is designed for a three-story 3955 ft² house in Virginia. The collector area is 1200 ft². (WDM)

25608 (COO—2560-1, pp 213-221) **Solar Rankine cycle (steam) drive and assistance to heat pump systems.** Lior, N. (Univ. of Pennsylvania, Philadelphia). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

This study analyzes various methods for reducing the purchased resource energy consumption of vapor compression heat pumps in both heating and cooling modes, in comparison with conventional systems. One of the methods studied is the application of a novel solar-powered, fuel-superheated Rankine cycle incorporating a steam turbine or rotary expander. System performance is augmented further in the heating mode by utilizing the waste heat from the cycle, as well as by solar energy.

25609 (COO—2560-1, pp 222-228) **Analytical comparison of solar assisted heat pump systems.** Cassel, T.A.V. (Bechtel Corp., San Francisco); Lorsch, H.G.; Lior, N. 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

The performances of six space heating systems for a 1500 sq ft Philadelphia one-family residence were compared. They are: electric resistance heat, combustion furnace, direct solar heating with auxiliary combustion furnace, conventional air-to-air heat pump, and two different solar assisted heat pump systems. Measured weather data were used to reconstruct day-by-day insolation and ambient temperature variations, and to determine resulting solar system performance values. Evaluation criteria were resource energy consumption, electric utility load factor, and return on consumer investment.

25610 (COO—2589-1) **Solar one data acquisition. Interim progress report.** (Delaware Univ., Newark (USA). Inst. of Energy Conversion). 25 Mar 1976. Contract E(11-1)-2589. 37p. Dep. NTIS $4.00.

Solar One has been instrumented with sensors for weather data system temperatures and pressures, house electrical loads, and photovoltaic system data. An automatic data acquisition and handling system has been designed and installed to gather and then transmit data to a central computer. Programs to summarize these data and tabulate them in convenient forms have been prepared. Initial data have been obtained and analyzed to check the sensor system and to give preliminary performance characteristics of the solar system. (WDM)

25611 (COO/2683—76/2) **General Electric Company study for defining the number of residential and non-residential projects, National Solar Demonstration Program.** (General Electric Co., Philadelphia, Pa. (USA). Space Div.). Apr 1976. Contract E(11-1)-2683. 144p. Dep. NTIS $6.00.

The methodology used to perform the "Parametric Study" to define a recommended demonstration program involved a decision making process. In this approach, selective solar buying factors were quantitatively evaluated for influencing key decision makers to install solar HVAC equipment. The selection of the recommended demo level also considered the probability of a decision maker actually seeing a demonstration as a function of how far he is located from a demo and how far he is willing to travel to see one. Demonstration levels of 200, 400, 800, 1600 and 3200 were assumed to determine the effects on Solar HVAC market penetration. The 800 demo level program is recommended to effectively stimulate the private sector to install solar HVAC systems. (WDM)

25612 (COO/2683—76/6) **Technology evaluation report for commercial demonstration program. Executive summary.** (General Electric Co., Philadelphia, Pa. (USA). Space Div.). Apr 1976. Contract E(11-1)-2683. 20p. Dep. NTIS $3.50.

This document contains a summary of the General Electric National Solar Demonstration Program, Technology Evaluation Report. The report assesses status and availability of solar heating and cooling equipment for inclusion in ERDA's "Commercial Demonstration Program" commensurate with ERDA 23A. Criteria have been developed which are to be met by solar hardware incorporated into the demonstration program. Assessments have been made, based on a survey of solar hardware manufacturers and developers, of when components, subsystems, and systems will be available for demonstration according to the technology status categories set forth in ERDA 23A. (WDM)

25613 (COO/2683—76/7) **General Electric Company study for defining the number of residential and non-residential projects, National Solar Demonstration Program.** (General Electric Co., Philadelphia, Pa. (USA). Space Div.). 1976. Contract E(11-1)-2683. 17p. Dep. NTIS $3.50.

The study was performed to provide an assessment of the number of residential and commercial demonstration projects required to accelerate the application of solar technology for the heating and cooling of buildings. The effectiveness of different levels of government sponsored solar demonstrations during the 1976—1980 time period has been analyzed. Future SHACOB market penetration achieved as a result of demonstration projects has been evaluated to the year 2000. Analysis of the subject has been performed through the development of a decision making modeling technique to provide quantitative results. (WDM)

25614 (ERDA—76-88) **Program description: solar energy for agriculture and industrial process heat.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Solar Energy). May 1976. 8p. TIC.

The Energy Research and Development Administration (ERDA) has established a program in Agricultural and Industrial Process Heat that embodies the direction, funding, and management of projects applying the direct conversion of solar energy to useful output for agricultural and industrial processes. The program shows considerable potential for replacement of fossil fuel energy (oil, natural gas, liquified petroleum gas and coal) with solar energy. (WDM)

25615 (LA-UR—76-1561) **Wallasey school.** Perry, J.E. Jr. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 28p. (CONF-760570—1). Dep. NTIS $4.00.

From Conference on passive solar heating and cooling; Albuquerque, New Mexico, United States of America (USA) (18 May 1976).

The Annexe of St. George's School, Wallasey, U.K., is situated on the west coast of England at 53.4° north latitude. Despite rather poor winter solar conditions, it has operated successfully since 1962. Thermally it is a hybrid system, deriving more than half of its heat from the sun, a substantial fraction from incandescent lighting, and a small fraction from the metabolic heat of the students. The immense double-glazed solar wall, 230 ft by 27 ft, covers the entire south face of the building. Internally there is massive thermal storage, with exterior insulation covering the roof and part of the north wall. Temperature control is accomplished by use of lights and ventilation, and by the students' choice of clothing. An extensive, modern data system was used to accumulate operational data for a 19-month period. A thoroughgoing, detailed analysis has been performed to elucidate the operation of this and similar buildings. This paper contains brief descriptions of the building and instrumentation and presents briefly some of the analytical and experimental results.

25616 **Heating and ventilation system.** Saunders, N.B. US Patent 3,952,947. 3 Dec 1974. vp.

A system is described for controlling the temperature, ventilation, illumination, and humidity within an enclosed building having at least one wall exposed to solar radiation comprising: a double glazed window mounted on the wall; means for measuring the net heat energy flow through the window; means for automatically adjusting the heat energy flow; means provided for absorbing at least a portion of the light and sun energy transmitted by the window; a heat sink thermally coupled to the building for storing some of the energy and means for circulating exterior air through the building. (WDM)

25617 **Application of solar energy. Proceedings of the first Southeastern conference held at Huntsville, Alabama, March 24—26, 1975.** Wu, S.T.; Christensen, D.L.; Head, R.R.; Whitacre, W.E. (eds.). Huntsville, AL; University of Alabama (1975). 654p. (CONF-750351—).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

Separate abstracts were prepared for individual items presented. (WDM)

25618 **UAH solar and wind energy program.** Christensen, D.L. (Univ. of Alabama, Huntsville). pp 3-14 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A number of programs related to solar and wind energy conversion, storage and application are currently underway. However, most of these programs are limited in scope, and are usually restricted to the study and development of either solar or wind energy utilization as a separate consideration. A systems approach and experimental test facilities are needed to combine these two prime alternate energy sources into hybrid systems augmenting one with the other. This appears to be inherently feasible based on the short and longer term (daily and seasonal) relationships they demonstrate. Programs have been initiated and facilities are being constructed at The University of Alabama in Huntsville to closely examine solar and wind energy relationships, development of cost-effective and efficient components and subsystems, and the design and integration of selected elements into residential applications. Other closely related activities underway are described herein.

25619 Status of Marshall Space Flight Center solar house. Humphries, W.R. (National Aeronautics and Space Administration, Huntsville, AL). pp 15-30 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

The Marshall Space Flight Center (MSFC) solar facility is described, and test results obtained from late May 1974 to September 1974 are discussed. This facility was assembled to provide operational experience in the utilization of solar energy for heating and cooling buildings. The major subsystems are the solar collector, the energy storage tank, the simulated living space, the air conditioning and heating subsystems, and the controls. These subsystems are described with emphasis placed on major results and conclusions. A cursory evaluation of the system for cooling is given from energy and power consumption viewpoints. This data evaluation indicates the current system is capable of supplying 50 percent of the thermal energy required to drive the air conditioner. A preliminary evaluation of winter data indicates that more than 90 percent of the heating required can be provided by the solar system.

25620 Summary of NASA-Lewis Research Center solar heating and cooling and wind energy programs. Vernon, R.W. (National Aeronautics and Space Administration, Cleveland). pp 43-66 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

NASA is planning to construct and operate a solar heating and cooling system in conjunction with a new office building being constructed at Langley Research Center. The technology support for this project will be provided by a solar energy program underway at NASA's Lewis Research Center. The solar program at Lewis includes: testing of solar collector collectors with a solar simulator, outdoor testing of collectors, property measurements of selective and non-selective coatings for solar collectors, and a solar model-systems test loop. NASA-Lewis has been assisting the NSF and now ERDA in planning and executing a national wind energy program. The areas of the wind energy program that are being conducted by Lewis include: design and operation of a 100 kW experimental wind generator, industry-designed and user-operated wind generators in the range of 50 to 3000 kW, and supporting research and technology for large wind energy systems. An overview of these activities is provided.

25621 Comparative evaluation of solar cooling concepts. Curran, H.M.; Alereza, T. (Hittman Associates, Inc., Columbia, MD). pp 305-325 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A comparison is made of three building cooling concepts which are primarily solar-powered. These are: (1) the solar Rankine concept in which a Rankine cycle driven by solar energy is used to drive a vapor compression refrigeration machine, (2) the solar-assisted Rankine concept in which a Rankine cycle driven by both solar energy and fuel combustion is used to drive a vapor compression refrigeration machine, and (3) the solar absorption concept in which solar energy is used to drive an absorption refrigeration machine. Both flat plate and concentrating solar collectors are considered. The comparison is made on the basis of the following four criteria: coefficient performance, collector area requirement, payback period, and requirements for primary (non-solar) energy. The general conclusion is that the solar-assisted Rankine concept is superior to the other two with respect to the first three criteria, and that the solar Rankine concept is superior to the other two with respect to the fourth criterion.

25622 Performance simulation for the design of solar heating and cooling systems. McCormick, P.O. (Lockheed Missiles and Space Co., Inc., Huntsville, AL). pp 327-332 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

One approach to solar heating/cooling systems design is considered—the cost effective system. Economics and fuel supply have for some time influenced the selection of heating systems for homes. Unfortunately for the home buyer, the economic considerations were usually those of the builder which are simply the lowest cost equipment and installation. In order for solar heating and cooling of homes to have widespread use, the builder and the buyer must reach an optimum compromise whereas the initial cost is low enough for the builder to sell the house yet the buyer can afford a combined house payment/fuel bill that is competitive with conventional systems. This optimization of initial cost versus operating cost is the final result in the design studies for cost-effective solar heated and cooled homes.

25623 Solar energy/heat pump alternatives for energy conservation in residential applications. Calvert, F.O.; Harden, D.G. (Univ. of Oklahoma, Norman). pp 359-371 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

This paper presents the results of design studies of solar energy coupled with heat pumps to achieve effective living complexes. The effectiveness of heat pumps, where effectiveness is defined as the ratio of the desired energy transfer to the original source energy, is greater than that for other commonly used environmental control equipment. By providing solar energy storage in a reservoir for the heat pump, the electrical energy required to power the heat pump may be leveraged so that as much as one or more watt-hours can be delivered for environmental control for every watt-hour of original fossil fuel source energy. The leveraging effect of the heat pump is its unique feature. An environmental control energy analysis for a 100-unit apartment complex (93 m^2 floor plan area for each apartment) considering seven possibie arrangements of using solar energy shows the electric energy demand can be reduced substantially. Utilizing solar energy for hydronic baseboard heating and a heat pump for cloudy days, a savings of 76 percent in electric usage for January may be effected. Energy savings for the other arrangements are less than this combination. The analysis indicates that solar energy must be competitive cost-wise with air-to-air heat pump installations. No technological breakthroughs are required to implement this system in new construction.

25624 Liquid subsystems for collection, storage, and distribution of solar heat. Smith, C.C.; Loef, G.O.G.; Ward, D.S. (Colorado State Univ., Fort Collins). pp 373-388 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

The Solar Energy Applications Laboratory of Colorado State University has designed, constructed, and is presently operating a solar energy system for the heating, cooling, and service hot water heating in a residential style building (Colorado State University/National Science Foundation Solar House I). An aqueous solution of ethylene glycol is used as the solar collection fluid, with water used for the storage and load distribution medium. Many of the components and materials incorporated in this system, while having been employed in other applications, are new to the building heating and cooling field. The special considerations which must be confronted in the assembly of an optimized solar heating and cooling system are discussed. Studies of the components required to efficiently transfer and store low temperature solar heat and to minimize loss of thermal availability are included. Several modes of operation permit critical comparisons of the subsystem components, materials, and engineering design. The performance of pumps, valves, and heat exchangers evaluated over a period of 8 months of operation, provides a basis for recommending specific designs, materials, and components as well as suggesting improvements in these areas.

25625 Low-temperature Rankine air conditioning. Bond, J.A.; Robertson, C.S. Jr. (General Electric Co., Valley Forge, PA). pp 389-404 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

The performance potential of a system consisting of a low temperature Rankine engine driving a conventional vapor compression air conditioner (or refrigerator) is discussed. Expander inlet temperatures in the 150°F to 250°F range, embracing temperatures typical of systems with solar heat sources, are considered along with condensing temperatures in the 80°F to 120°F range. System performance limitations imposed by the performance of key components including the expander, refrigeration compressor, and heat exchangers are outlined. Tests of a breadboard development system are described. The Rankine engine uses R-11 as the working fluid and includes a rotary multi-vane expander. The measured overall coefficient of performance for the breadboard system was in the 0.4 to 0.48 range. Expander efficiency in the breadboard system was 65 percent. An improved expander has a measured efficiency of 75 percent and it appears that an efficiency of 80 to 85 percent is within reach. A solar heated system which might be used for cooling of buildings is described. Typical solar collector areas are shown as a function of condensing and evaporator temperatures. An optimization of evaporator temperatures is outlined in terms of evaporator and collector capital costs. An assessment is made of the cost effectiveness of supplemental heat addition or electric motor augmentation of the expander.

25626 Solar heating and cooling of mobile homes. Macklis, S.L. (General Electric Co., Valley Forge, PA). pp 437-449 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

Existing design tools and techniques were utilized to design a system using presently available equipment to heat and cool a standard mobile home. The solar system is completely integrated into the mobile home with the entire package designed to be factory assembled and road transported in a conventional manner. (WDM)

25627 Design, performance, and architectural integration on solar heating system using reflective pyramid optical condenser. Wormser, E.M. (Wormser Scientific Corp., Stamford, CT). pp 451-460 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

This paper describes the design and performance properties of a solar heating system employing a reflective pyramid optical condensing system. The optical focusing system concentrates solar energy by a factor of 3 to 5X and reduces the requirement for flat plate collectors by that factor. By concentrating the solar energy, the density of radiation at the flat plate collector and, as a result, the rise in temperature are both increased, and the losses are minimized. Results of comparative tests of the focusing system and a flat plate unit of comparable size are reported. Examples are given of the architectural integration of the system with dwellings of conventional design. The system is easily integrated with only minor changes in architectural design and minimum effect on aesthetic appearance.

25628 Solar heating a Boston school. Notestein, J.E. (General Electric Co., Valley Forge, PA). pp 461-483 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

This paper describes the design and construction of one of the first large scale solar heating systems operated in this country. The system is installed on the Grover Cleveland Middle School in Dorchester, Massachusetts, an urban community to the south of Boston. The system design consisted of a 4608 square foot, three row array, utilizing a water/glycol fluid loop and 144 flat plate collectors. Installation of the array supporting steel started on February 13 and was completed on February 20. Solar collectors and the control console were delivered to Boston on February 25. Installation proceeded rapidly and the Grover Cleveland School was among the first solar heating experiments on line for continuous operation when heat was supplied at 4:10 P.M., March 6 (41 days after contract go-ahead).

25629 Comparative performance analyses of three solar heated and cooled buildings. Winn, C.B.; Johnson, G.R. (Colorado State Univ., Fort Collins). pp 499-510 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

This paper presents the results of comparative performance analyses for three solar heated and cooled buildings located in Colorado. The first building is the CSU Solar House 1; this house was completed in July, 1974 and a performance data collection program has been in operation since August, 1974. The house contains approximately three thousand square feet of floor area located in two floors; the solar system consists of approximately 750 square feet of collectors, an 1100 gallon water storage tank, an 80 gallon pre-heat tank for service hot water, a 3 ton lithium bromide absorption refrigeration unit for air conditioning, and appropriate heat exchangers, valves, and pumps. The collector working fluid is a mixture of water and ethylene—glycol. The second building contains approximately 3500 square feet of floor area located on two floors. It uses air as the transport medium rather than water and utilizes 1200 square feet of collectors. The thermal storage unit consists of approximately 6000 pounds of rocks stored in the crawl space beneath the living room. This house is presently near completion. The third house is CSU Solar House 2, which is similar in design to CSU Solar House 1, but is also designed to be an air system.

25630 Solar heating of a commercial office building. Gilman, S.F. (Pennsylvania State Univ., University Park). pp 511-515 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

This commercial office building was constructed in Albuquerque, N.M. in 1956 by the owners, Bridgers and Paxton Consulting Engineers, Inc. and since that time has been owned and occupied by the firm. In 1956, it was the first known solar-heated office building in the world. The building has a heat pump assisted solar energy heating system which was designed by the firm for its own evaluation of the potential of solar energy. The principal elements of the system serving 4300 sq ft of single story office space are the 750 sq ft water-type solar collector, a 6000 gallon underground water storage tank, one water-to-water heat pump, and five water-to-air packaged heat pumps. (WDM)

25631 Integrated home energy system. Long, C.H. (Virginia Polytechnic Inst. and State Univ., Blacksburg). pp 521-537 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

In this project, it was found that much energy in the form of heat is being wasted in a typical household of today. Methods of saving and using this wasted energy were looked at and the most practical and feasible way to use this wasted heat was determined to be a hot water preheater. The heat in the drain water from the dishwasher, clothes washer, and shower could be transferred and stored in the incoming cool water which was to be heated by the hot water heater. In a similar manner, the hot air from the clothes dryer could be ducted through a heat exchanger contained in the preheater in order to extract most of the heat. Due to inefficiencies in heating and cooling systems in the average home, different methods of heating and cooling the house were researched. A combination of solar heating and a heat pump was chosen. The heat pump does all of the air conditioning in the summer and acts as an auxiliary heater in the winter. The solar panels provide hot water for heating, hot water for washing, and hot water to heat the air in the clothes dryer. An integrated home energy center, as described in this report, was found to be feasible at the present time in terms of annual equivalent cost as compared to a normal present day household. If the cost of energy increases as has been predicted, the integrated system outlined in this report becomes much more practial and the savings become much greater.

25632 Architectural constraints on solar applications to housing. Watson, D. (Yale School of Architecture, Guilford, CT). pp 89-102 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

This paper discusses the position that constraints upon widespread use of solar technology for house heating are imposed by requirements of architectural design. One such requirement is to accommodate a large collector area on a building envelope that itself must be kept within thermally efficient ratios of external surface to enclosed space. A second requirement, particularly important for medium-density housing, is to allow a wide variety of design alternatives. The paper reviews design alternatives that were systematically generated on the basis of a conventional house form, double storied with length-to-width ratios held within a 1.5

maximum, (beyond which heat losses through the external envelope are significant). Of forty combinations, only three alternatives approximate a collector area equal to 50 percent of the enclosed area. Many more design alternatives are found when the collector area is less than 40 percent of the heated floor area. A 20 percent collector-to-floor-area ratio permits a full range of design alternatives and therefore presents few architectural constraints.

25633 Economic aspects of solar energy in the Southeast. Ziemke, M.C.; Ponder, C.A. (Chrysler Corp., Huntsville, AL). pp 103-111 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

There have been several recent studies of the economic feasibility of early, widespread use of solar energy for heating and cooling buildings and providing their hot water requirements. These studies indicate that one- or two-story commercial or residential buildings with low internal heat loads are optimum for combined solar heating/cooling systems, which are needed in the southeastern U.S. This paper addresses several facts about this subject which have not been given serious consideration in previous economic studies. It is shown that solar energy systems for buildings have only marginal economic attractiveness by 1985, if their delta cost can be kept below $5,000 for a typical single-family residence and if regional energy costs increase 100 percent from present levels.

25634 Environmental exposure considerations in solar heating and cooling systems. Yen, H.H.; Reese, D.R. (Wyle Labs., Huntsville, AL). pp 113-119 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

Public acceptance of solar heating and cooling systems will depend on a variety of factors which are both complex and to some extent, subject to future government actions. One of the most important factors regardless of other stimuli will be cost and a reasonable expectation of a long trouble-free lifetime. The authors have examined the principal elements of solar heating and cooling systems for sensitivity to environmental exposure particularly in regards to degradation in performance and life expectancy. In addition, a review was made of currently available national and industrial standards in regards to test requirements and certifications which could have an impact on the design and commercial application of solar heating and cooling systems.

25635 Design guidelines for solar heating systems. Shoup, T.E.; Fletcher, L.S. (Rutgers-the State Univ., New Brunswick, NJ). pp 269-282 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

This paper presents a discussion of recent literature related to design procedures for residential applications of solar heating. The objectives of this review are three-fold: to establish a classification scheme for categorizing various design procedures presented in the literature; to provide a summary of some of the more important general design guidelines gleaned from the literature; and to recommend where further efforts in the design literature need to be made.

25636 Solar space heating with aquifer heat storage: a design study. Brothers, R.C. (E.I. DuPont de Nemours Co., Inc., Victoria, TX); Wilhite, C.P. pp 293-304 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A study was conducted to explore the technical and economic feasibility of converting the campus heating system at the University of Kansas to one utilizing solar thermal energy and aquifer storage of heat. Objectives of the study were: (1) to assess the capability of geological formations underlying the campus to efficiently store large volumes of heated water, and (2) to estimate the economics of the proposed system for a pilot demonstration project on campus and a full campus-wide solar heating system. Computer simulations showed aquifer storage of hot water in the Tonganoxie aquifer to be technically practical for the proposed pilot project. Energy storage efficiencies were relatively low, thus increasing initial costs and causing the cost of energy derived from the pilot system to be prohibitively high. However, storage efficiencies improved significantly when data were scaled up to a size comparable to a campus-wide system. Costs of energy derived from the scaled-up system are shown to be slightly less that that for a grassroots coal fired installation, but significantly more expensive than heat derived from the existing natural gas/fuel oil fired boiler.

25637 Solar air conditioner. O'Hanlon, E.J. US Patent 3,964,678. 22 Jun 1976. Filed date 4 Nov 1974. 4p.

An inexpensive solar air conditioning system simple to install and operating with a minimum of mechanism. Without any water drip, so customary with the usual air conditioning equipment, it will bring into a shelter structure either cooled air or air warmed by noncostly solar energy.

25638 Heating and cooling system. Petersen, R.K. US Patent 3,965,972. 29 Jun 1976. Filed date 4 Nov 1974. 8p.

An environment heating and cooling system is described which consists of a solar collector, heat storage ground well, cold storage ground well, and a heat exchange apparatus. Water from a cold storage ground well is heated in the heat exchange apparatus by solar heating fluid heated in a solar collector. The heated water is stored in a heat storage ground well. Water from the heat storage ground well heats the ambient environment when the solar collector requires supplementation. Water from the cold storage ground well is used to cool the ambient environment. In addition, water from both ground wells serves ordinary household purposes as drinking, bathing and the like.

DISTILLATION

25639 Concentration of underground brines in situ by solar evaporation. Sadan, A. US Patent 3,966,541. 29 Jun 1976. Filed date 20 Feb 1975. 10p.

A process is provided for the recovery of chemicals, such as chlorides, sulfates, carbonates, and borates of such alkali metals as sodium and potassium, among others, from underground brines associated with an ore body containing said chemicals, wherein the underground brine is pumped to the surface and confined over said ore body where it is concentrated by solar evaporation and the concentrated brine returned to an underground basin adjacent said ore body and stored for later removal by pumping for the subsequent recovery of chemicals therefrom. Thus, solar evaporation is used to produce the desired concentration of brine to optimize the subsequent recovery of chemicals therefrom, thereby resulting in substantial savings in overall energy costs.

DRYING AND CURING

25640 Use of solar energy in a soybean processing operation. Reisz, A. pp 539-549 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

In a soybean processing operation, large quantities of fossil fuels are required to convert soybeans into high protein food stuff and vegetable oil. There are several possible areas of application of solar energy in soybean processing. The most obvious area of application and the area with the most research data available to date is in grain drying. There are several possible modes of drying soybeans; they can be dried in the storage bin and they can be deployed in large areas exposed to the sun. Wind power can also be integrated with solar power to give a smoother application of non-fossil energy. With energy storage capability, grain drying with a solar-wind hybrid system can possibly be self-sufficient. Other processes in a soybean processing operation can possibly use solar energy although it is not practical at this time. Evaporators, condensers, heaters, and coolers in the operation can possibly be powered by solar and wind energy. A soybean processing operation has considerable materials movement and this too can possibly be powered by solar and wind energy.

WATER HEATING

REFER ALSO TO CITATION(S) 25990

25641 Hot-water usage in a typical single-family residence. Johnson, R.J.; Angleton, H.D. (NAHB Research Foundation, Inc., Rockville, MD). pp 433-435 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

The NAHB Research Foundation, Inc., is currently monitoring the usage of hot water in a typical single-family residence prior to the addition of a solar assist conversion as a supplement to the

existing natural gas energy source. The family is using approximately 17.75 gallons of hot water and 19,800 BTUs of gas energy to heat this water per person per day. The water heater has an apparent overall operating efficiency of 57 percent. Observations of hot water and gas energy usage will continue after the solar assist conversion is made.

25642 Performance analysis of solar service hot water systems in the northwestern United States. Winn, C.B.; Soot, P.M.; Szmyd, W.R. (Colorado State Univ., Fort Collins). pp 485-498 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

Weather data for various locations was derived from data gathered from seven weather reporting stations. Due to the incompleteness of the data from the stations computerized statistical routines were used on this data to generate representative hourly values for solar insolation and temperature. The configuration to be used at these installations consists of a flat plate collector, a sixty-six gallon thermal storage tank, a conventional water heater, a pump, and the appropriate flow check values, draining values, and piping. The performance of this system at each installation is presently being simulated using program SIMSHAC at Colorado State University. The purpose of the study is to provide detailed performance and cost data of solar service hot water systems in the northwestern United States and to identify positive and negative factors influencing the acceptance of solar energy as an alternative energy source. This paper presents some of the results from the simulation studies.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 25545

25643 (CONF-751181—, pp 10p, Paper 4) **Natural comfort systems.** Hay, H. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

A short philosophical discussion is presented on the heat-transfer properties of surfaces. (WDM)

25644 (CONF-751181—, pp 5p, Paper 10) **Origin and development of flat-plate collectors.** Yellott, J.I. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

A short discussion on the origin, operation, and efficiency of flat plate collectors is presented. (WDM)

25645 (CONF-751181—, pp 28p, Paper 13) **Solar testing and experimentation.** Zerlaut, G. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

Pyranometers and pyrheliometers are described and calibration of these instruments are discussed. Measurements and use of insolation data are discussed. Testing programs on flat plate collectors, solar device materials, test mounts, etc. are described. (WDM)

25646 (COO/2672—76/2) **Exposure testing and evaluation of solar utilization materials. Quarterly progress report, November 1, 1975—January 31, 1976.** Gilligan, J.E. (IIT Research Inst., Chicago, Ill. (USA)). Jun 1976. Contract E(11-1)-2672. 6p. Dep. NTIS $3.50.

A one page summary is given for the progress made from Nov. 1, 1975 through Jan. 31, 1976. (WDM)

25647 (SAND—76-5141) **Optical materials for solar energy applications.** Mattox, D.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1976. 43p. (CONF-760206—3). Dep. NTIS $4.00.

From The topical meeting on image processing; Pacific Grove, California, United States of America (USA) (24 Feb 1976).

The application of optical materials to solar energy utilization is reviewed. It is shown that hundreds of square miles of optical materials will be required every year to have a significant input on the U. S. energy economy. Most of these materials will have to be fabricated at a very low areal cost. Various high-volume, low-cost production processes applicable to solar-optical materials are presented. Major challenges to the optical technologist will be to control the optical properties of materials being fabricated at very high production rates and to develop new low cost optical materials.

25648 Solar collector having oxygen-deficient PbO_2 coating. Schmidt, F.J. (to Ametek, Inc.). US Patent 3,958,554. 2 Jul 1964. vp.

A solar energy collector system comprising a heat transfer member, a surface coating of oxygen-deficient PbO_2 on said member, means feeding fluid into heat transfer relation to said member, and means for feeding fluid from said member to a zone of utilization is described.

25649 Solar energy converter. Pei, Yu.K. (to Owens-Illinois, Inc.). US Patent 3,952,724. 24 Jun 1974. vp.

The design for an evacuated tube solar collector is presented. The fluid handling system is detailed. (WDM)

25650 Lightweight reflective panels for solar-thermal power plants and methods of forming such panels. Caplan, H.W. US Patent 3,959,056. 1 Jul 1974. Filed date 19 Oct 1973. vp.

A process is described for forming an elongated lightweight curved reflective panel for use in solar-thermal systems, comprising the steps of: (a) forming an expansible core structure; (b) forming a self-supporting parabolic panel of substantially uniform thickness in a substantially continuous process; and (c) securing a reflective material to said mounting surface to provide a reflector. (WDM)

25651 Solar heat collector. Wilson, L.T. Jr. (to Wilson Solar Kinetics). US Patent 3,954,097. 16 Sep 1974. vp.

A solar heat collector for heating water or other fluid heat exchange mediums is described, said collector comprising: an elongated heat exchanger providing two fluid flow paths each extending substantially the full length of the exchanger; a heat trapping annular shield of optically transparent material surrounding the heat exchanger and extending along a major portion of its length; an elongated reflector having an elongated and generally parabolic reflecting surface which focuses incident solar energy onto a focal line extending along the length of the reflector; and means for mounting the reflector relative to the heat exchanger with the heat exchanger generally colinear with the focal line. (WDM)

25652 Solar energy trap. Brantley, L.W. Jr. (to National Aeronautics and Space Administration). US Patent 3,958,553. 29 Oct 1974. vp.

A solar energy trap featuring an elongated tubular light pipe for trapping and absorbing electromagnetic radiation waves emitted from the sun and for converting the radiation waves into thermal energy for heating a fluid is described. (WDM)

25653 Solar collector—heat exchanger. Worthington, M.N. US Patent 3,957,109. 31 Oct 1974. vp.

A solar collector is described which features a heat exchanger, movable sun shade, forced air blower, and water spray system. (WDM)

25654 Solar heater and thermal barrier. Angilletta, D.J. US Patent 3,960,135. 26 Nov 1974. vp.

A solar heater for attachment to the inside of windows of buildings is described. It comprises a box assembly having a rear panel member including heat exchanger means and top, bottom and spaced side panels forming a box enclosure with the rear panel and having air passages in at least one of the panels. (WDM)

25655 Solar energy reflecting film structure and process of manufacture therefor. Moynihan, R.E. (to E. I. Du Pont de Nemours and Co.). US Patent 3,958,062. 3 Dec 1974. Filed date 16 Mar 1972. vp.

A laminated reflecting film structure of polyvinyl acetal is described. Opaque metal platelets (5 to 43 microns) are dispersed in the polyvinyl acetal. (WDM)

25656 Solar heat pump. Ruff, J.D.; Wheeler, P.R. US Patent 3,960,322. 17 Dec 1974. vp.

A solar assisted heat pump is described and illustrated. The operation of the heat pump is explained. (WDM)

25657 Experimental evaluation of a solar concentrator. Hastings, L.J. (National Aeronautics and Space Administration, Huntsville, AL). pp 333-358 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

Analytical studies have been directed primarily toward support of test hardware selection/design. Three types of concentra-

tors have been studied: parabolic reflector, Fresnel lens, and Fresnel reflector. A parabolic reflector geometry and its focusing characteristics were defined. A simple ray analysis has been developed to determine the transmission and concentration characteristics of an ideal Fresnel lens oriented with grooves away from the sun. Cursory design requirements on groove angles, transmission coefficients, f-numbers, and concentrated image profiles have been generated. Similarly, a Fresnel reflector study was performed. The manufacturing/maintenance advantages of the plastic Fresnel lens make it the favored approach at present. The collection tube assembly performance sensitivity to surface coatings, convection losses, shielding techniques, and the effects of localized heating were also studied analytically. (WDM)

25658 Analysis for designing solar concentrator-collector configurations. McDermit, J.H. (Lockheed Missiles and Space Co., Inc., Huntsville, AL). pp 405-429 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

An analysis for predicting the heat flux distribution on collectors in the focal region of solar concentrators has been formulated. The analysis is rather general and can consider limb darkening effects, collector placement errors, concentrator optical errors, and concentrator pointing errors. By coupling finite differencing techniques and heating requirements to this analysis, it can also be used to design concentrators that give prescribed heating on the collector surface. Illustrative results are presented. It is concluded that the concentrator and collector should be designed as a unit and that concentrator configurations that are more desirable than the paraboloid and cylindrical parabola can be designed.

25659 Design of the solar heating system for Grassy Brook Village condominium. Hartman, D.L. (Dubin-Mindell-Bloome Associates, New York). pp 517-519 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

The development of a performance specification for solar collectors was based on the need for a standard but flexible specification that defined flat plate, liquid flow solar collectors by the major parameters affecting performance. (WDM)

25660 Outdoor performance testing of flat-plate solar collectors. Zerlaut, G.A.; Dokos, W.T. (Desert Sunshine Exposure Tests, Inc., Phoenix, AZ). pp 121-140 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

Two major problems encountered in outdoor testing are those of obtaining both a stable low wind across the collector and a stable solar flux (no clouds). While baffles can be employed, they present an aperture problem except at solar noon, especially if they are sufficiently close to the collector to minimize wind effects. Also, even on cloudless days, the rapidly changing insolation rate permits accurate testing only during a 2- to 3-hr period centered about solar noon. Both of these problems are largely eliminated by employing an equatorial, follow-the-sun mount. Attention is therefore devoted to the technical and economic advantages of utilizing an exactly-normal-incident (ENI) mount (equatorial follow-the-sun) for comparison testing and rating of collectors. Typical daily summer and winter insolation curves are presented in support of the preference for testing on a sun-following mount; data are given for various angles, and on an ENI mount, for New River, Arizona. The other major problems encountered in collector testing, problems that are heightened by outdoor testing, are slight variations in mass flow and inlet temperature. A gravity-feed outdoor test facility is described that minimizes these problems and permits accurate, rapid testing.

25661 Design and characterization of solar concentrators. Anderson, D.E.; Thayer, D.A.; Sahl, H.B. (Shelrahl, Inc., Northfield, MN). pp 143-155 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

High performance, potentially inexpensive reflective concentrators can be fabricated for both single-axis (e.g., parabolic trough) and double axis (e.g., central receiver) solar thermal systems. Examples of designs of both systems are presented which show that the specular reflectance function must be measured in order to characterize candidate mirror systems. Depending on desired concentration ratio, the reflectance acceptance criteria for the concentrator may range from perhaps 20 milliradians for single-axis systems with concentration ratios of 10 to 30, to perhaps 4 milliradians for central receiver systems with concentration ratios of over 1000. Inexpensive metalized plastic mirrors have been fabricated which satisfy the most demanding of criteria, with approximately 90 percent specular reflectance within +-2 milliradians. Details of fabrication, reflectance testing and weatherability testing are summarized for a variety of candidate materials. Examples of taut planar membrane mirrors for use in a central receiver solar-thermal power plant, and of rigid reflective line focus mirrors for use in a linear array for intermediate temperature applications, are described.

25662 Predicted performance of transparent plastic honeycomb solar collectors. Wedel, R.K.; Marshall, K.N. (Lockheed Palo Alto Research Lab., CA). pp 157-170 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A study is presented on the use of transparent plastic honeycombs in flat plate solar collectors for improvement of efficiencies at elevated temperatures (180° to 240°F). The honeycomb concept is discussed, and the advantages of using transparent honeycomb are presented. The theory used to analyze the honeycomb collector systems is discussed. For five transparent plastics, the single film measured radiation properties are given. From the measured data the effective emittances of the honeycombs were calculated. Finally, predicted efficiencies for honeycomb systems are given for various honeycomb aspect ratios and absorber plate coatings. Comparisons are made between the different honeycombs and with other designs.

25663 Design of an enhanced flat-plate solar collector. Fletcher, L.S.; Ahiskali, S. (Rutgers-the State Univ., New Brunswick, NJ). pp 171-177 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

The design, fabrication, and preliminary testing of an enhanced flat plate solar collector for water heating is presented. The enhanced collector combines the advantages of both flat plate collectors and concentrating collectors by incorporating a two-stage heating process. The primary stage heats the water by means of the standard absorption process and the secondary stage utilizes the heated water from the primary stage and increases the temperature by means of longitudinally placed parabolic reflectors. Preliminary experimental results demonstrate that higher temperatures may be achieved per unit area with the enhanced collector than with a more conventional flat plate collector.

25664 Parabolic collector using composite construction. Rojeski, P. Jr.; Sams, G.W. (Univ. of Tulsa, OK). pp 179-188 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

In southern portions of the United States, summer residential air-conditioning power requirements usually exceed winter heating demands. For this reason the University of Tulsa has been experimenting with high-efficiency, high-temperature collectors to enhance the operation of absorption air conditioning units and to increase the potential for electrical power generation. The concentrating collectors receiving the most attention have been the parabolic configuration and the Fresnel lens unit. This paper reports on the progress made in developing a durable, lightweight, economical parabolic collector capable of high efficiencies at operating temperatures in excess of 200°F. (WDM)

25665 Thin-film-coated cover plates for solar collectors. Taylor, R.P.; Viskanta, R. (Purdue Univ., West Lafayette, IN). pp 189-207 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

The prospect of improving the performance of a flat plate solar collector by the use of an optically selective cover plate is investigated. An optically selective cover plate is one that has a high solar transmittance and at the same time a high infrared reflectance. To this end, a steady one-dimensional collector model is developed to predict the performance of collectors with selective cover plates. (WDM)

25666 Development of a prototype faceted fixed-mirror solar concentrator. Williams, J.R. (Georgia Inst. of Tech., Atlanta). pp 209-227 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

In early 1974 a 61 ft² concentrator of unity aspect ratio was built at Georgia Tech. NSF Grant GI-43936 was initiated on July 1, 1974, and two related parallel tasks were begun: (1) the collection and analysis of data from the 61 ft² concentrator, and (2) the design and construction of a 540 ft² concentrator of large aspect ratio. The 61 ft² concentrator was shown to perform just as the theoretical analysis had predicted. The performance of the 540 ft² concentrator is being measured and compared with the results of a numerical analysis. (WDM)

25667 Solar collector testing by calorimetry. Lee, W.D. (Arthur D. Little, Inc., Cambridge, MA). pp 229-234 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A device for measuring the rate of heat collection of a solar collector has been developed. It is based on flow calorimetry. The test technique minimizes set-up requirements and provides quasi steady closed loop collector operation without the need of a heat rejection system. The data output is an instantaneous collector heat rate pickup signal for recording during the test.

25668 Simulation study of a solar flat-plate collector. Reuland, W.B.; Russell, W.E.; Scott, J.B. (Clemson Univ., SC). pp 235-247 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A simulation model of a solar flat-plate collector has been developed that combines the heat transfer and energy balance of a solar collector with local climatic conditions. The model allows the user to study the effects of design parameter changes for the collector and system operation and control strategies for systems using flat-plate solar collectors. Meteorological conditions including insolation and steady-state operation of the collector are calculated using random sampling techniques for each 15-minute interval throughout the year. The model operates successfully, properly demonstrating the effects of collector design parameter changes. Use of such a model is recommended in conjunction with all system designs or feasibility experiments incorporating flat-plate solar collectors. The meteorological condition model with its 15-minute variations can provide a more valid simulation than a model using monthly or daily averages. (WDM)

25669 Application of thermic diode solar panels. Buckley, S. (Massachusetts Inst. of Tech., Cambridge). pp 249-265 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

Thermic diode solar panels are a new method of collecting, controlling, and storing solar energy. These panels, incorporated into the walls and roof of a building, absorb solar energy on a winter day but become insulators on a winter night. During a summer day they become insulators but dissipate heat during a summer night; thus both heating and air conditioning costs are saved. Since the panels cost about as much as the walls and roofs they replace, there is no high first cost associated with conventional solar energy systems for buildings. Thermic diode panels have no moving parts and require no external power other than that provided by the sun. Both vertical wall and angled roof orientation are possible.

25670 Principles of solar concentrator design. Burkhard, D.G. (Univ. of Georgia, Athens). pp 283-291 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A differential equation is obtained for the shape of a reflecting surface which will distribute axially symmetric light intensity into a specified irradiance over a receiver which is symmetric about the direction of the incident light. Results are applied to the design of rotationally symmetric solar reflectors and also to a two-dimensional geometry, that is, one in which the reflector is a cylinder with its axis perpendicular to the incident beam.

25671 Solar energy collection system. Moan, K.L.; Pei, Y.K. (to Owens-Illinois, Inc.). US Patent 3,960,136. 20 Feb 1975. vp.

An evacuated tube solar collector featuring closed-cycle gas cooling and a heat exchanger is described. (WDM)

25672 Structurally integrated steel solar collector. Moore, S.W. (to Energy Research and Development Administration). US Patent Application 583,374. 3 Jun 1975. 5p.

Herein is disclosed a flate plate solar heat collector unit. The solar collector is integrated as a structural unit so that the collector also functions as the building roof. The functions of efficient heat collection, liquid coolant flow passages, roof structural support, and building insulation are combined into one unit.

25673 Means of increasing efficiency of CPC solar energy collector. Chao, B.T.; Rabl, A. (to Energy Research and Development Administration). US Patent Application 590,980. 27 Jun 1975. 9p.

A device is provided for improving the thermal efficiency of a cylindrical radiant energy collector. A channel is placed next to and in close proximity to the nonreflective side of an energy reflective wall of a cylindrical collector. A coolant is piped through the channel and removes a portion of the nonreflective energy incident on the wall which is absorbed by the wall. The energy transferred to the coolant may be utilized in a useful manner.

25674 End-clearance effects on rectangular-honeycomb solar collectors. Edwards, D.K.; Arnold, J.N.; Catton, I. (Univ. of California, Los Angeles). *Sol. Energy;* **18**: No. 3, 253-257(1976).

Results are reported of an experimental program to measure the effects of gaps between a honeycomb core and its coverglass and absorber plate. Nusselt numbers up to values of 2 vs Rayleigh number are reported for gaps of 0, 1.5, 2.3, 3.0, and 4.6 mm above and 0 and 1.5 mm below a 19 mm thick honeycomb core with 4.69 x 40.3 mm rectangular cells. The nontranspired honeycomb system was heated from below and oriented at 0°, 15°, and 30° from the horizontal with the long dimension of the cells running horizontally. The results indicate that a well-designed honeycomb core will give good performance in a solar collector even with clearance gaps of 1.5 mm above and/or below the core.

25675 Solar radiation collector and concentrator. Hockman, V.J. (to Oak Ridge Solar Engineering, Inc.). US Patent 3,964,464. 22 Jun 1976. Filed date 8 Apr 1975. 8p.

A device is described for concentrating solar radiation upon the surface of a helicoidal tube assembly containing a circulating heat transfer medium whereby the energy of said radiation may be collected and utilized. The device consists of a rectangular container wherein is supported a longitudinal plurality of aligned curved reflectors for gathering and concentrating incident solar radiation, multiple vertical reflectors to gather low-angle radiation, a convex radiation concentrating reflector beneath said helicoidal tube and a means for damping excess solar radiation. A method is given for the utilization of said solar radiation collector whereby the heated circulating medium provides the means for heating and cooling buildings.

25676 Process for producing solar control window. Willdorf, M.E. (to Material Distributors Corp.). US Patent 3,891,486. 29 Jun 1976. Filed date 22 Sep 1975. 6p.

Reissued June 29, 1976, Re. 28,883.

A solar control film for application to window glass is described which comprises a vapor deposited aluminum coat, interposed between a pair of moisture permeable polymeric strata, each of which is self supporting. In one modification, an optional outer coat on one of the polymeric strata is composed of a pressure sensitive adhesive in association with a silicone release sheet. In another modification, an optional outer coat on the other of the polymeric strata is composed of a silicone release agent. 5 claims, 4 drawing figures.

GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 25987

25677 (UCRL—52000-76-3) Energy and technology review. Carr, R.B.; Crawford, R.B.; McCaleb, C.S.; Prono, J.K. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1976. Contract W-7405-eng-48. 24p. Dep. NTIS $3.50.

Separate articles are included on technology transfer, modular microcomputers, and national security. A separate abstract was prepared for an included article on geothermal scaling and corrosion. (MOW)

RESOURCE STATUS AND ASSESSMENT

REFER ALSO TO CITATION(S) 25993

USA

25678 (NP—20944) **Project Independence. Final task force report: geothermal energy.** (Federal Energy Administration, Washington, D.C. (USA)). Nov 1974. 123p. GPO $2.00.

This report contains the final technical analysis of the Project Independence Interagency Geothermal Task Force chaired by the National Science Foundation. The potential of geothermal energy, resources, fuel cycles, and the status of geothermal technology are outlined. Some constraints inhibiting rapid and widespread utilization and some Federal actions to remove utilization barriers are described. (MOW)

25679 (NP—20978) **Potential of low-temperature geothermal resources in northern California. Report No. TR13.** Hannah, J.L. (California Div. of Oil and Gas, Sacramento (USA)). 1975. 58p. California Div. of Oil and Gas, Sacramento $2.50.

Economically feasible uses for geothermal heat at temperatures too low for conventional electrical power generation at present are delineated. Several geothermal resource areas in northern California that have development potential are described, and applications of the heat found in each area are suggested. Plates are included of the following field study areas: the east side of the Sierra-Cascade Range north of Bishop, and the northern Coast Range from San Francisco Bay to Clear Lake. The counties included in the study area are Mo doc, Lassen, Sierra, Plumas, Placer, Alpine, Mono, Mendocino, Lake, and Sonoma. (LBS)

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 25679

GEOPHYSICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 26660

25680 **Spectral analysis of gravity and magnetic anomalies.** Leu, L.K. Berkeley, CA; Univ. of California (1975). 176p. University Microfilms Order No. 76-15,282.

Thesis (Ph. D.).

A new method for the interpretation of the potential field data has been developed. It is based on the analysis of the spectra of an anomaly and its moments. For two-dimensional structures with polygonal cross-sections, expressions for the spectra of the anomalies and their moments are derived. These expressions consist of, except for a factor, sums of exponentials, in which the complex exponents are functions of frequency and the coordinates of the locations of the edges of the polygonal cross-section. Exponential approximation method has been utilized for generating a system of linear equations from the sums. The above spectral approach is here extended to the interpretation of the potential field anomalies due to three-dimensional bodies. These bodies are assumed to be represented by vertical prisms. The expressions for the spectra of the anomalies and their moments have been derived and are found, as in the case of two-dimensional bodies, to consist of sums of exponential functions. The exponential approximation method is employed to determine the depths to the tops and bottoms of the causative bodies. The bottom of the magnetized crust determined from the spectral analysis of residual magnetic anomalies is generally interpreted as the level of the Curie-point isotherm. The spatial variation of the Curie-point isotherm level in Yellowstone National Park has been studied with the help of aeromagnetic data. A very shallow isothermal surface at a depth of only 5—6 km below sealevel is associated with the central part of the Yellowstone caldera. Except in a few localized spots, the isotherm deepens considerably in the areas of hydrothermal alteration, fumaroles and boiling springs in the part, this study indicates a strong correlation between the spatial variation of the Curie isotherm level and the concentration of subsurface geothermal energy.

ECONOMIC AND FINANCIAL ASPECTS

25681 **Capital and electric production costs for geothermal power plants.** Klei, H.E. (Univ. of Connecticut, Storrs); Maslan, F. *Energy Sources;* 2: No. 4, 331-345(1976).

Electric power generation from geothermal wells is projected to increase within the immediate future. Plant sizes were optimized to show that there is little incentive to build plants above 100 MW in size. Power production costs were calculated for dry-steam, hot-brine, and hot-rock wells, and were found to lie between 4 and 8 mills/kWh.

ENVIRONMENTAL ASPECTS

25682 (EQL-Memo—17) **Geothermal development and the Salton Sea.** Goldsmith, M. (California Inst. of Tech., Pasadena (USA). Environmental Quality Lab.). Feb 1976. 18p. Environmental Quality Lab., Pasadena, CA.

The relationship of the Salton Sea, a key element of the Imperial Valley water system, to potential geothermal development in that region is studied. The effects of direct discharge of brines into the Sea are discussed along with the use of Salton Sea water for cooling the geothermal power plants. Methods for controlling the salinity of the Salton Sea are described. (MOW)

25683 **Ambient air quality in the vicinity of geothermal power generating plants.** Altshuler, S.L. Pittsburgh; Air Pollution Control Association (1975). 11p.

From 68. annual meeting of the Air Pollution Control Association; Boston, MA, USA (15 Jun 1975).

The emission of hydrogen sulfide (H_2S) during the utilization of geothermal steam and its effect on air quality at The Geyers in Northern California are discussed. Ambient air surveys performed at The Geyers during the last 5 yr have shown significant concentrations of H_2S within the heavily developed area of The Geyers. H_2S concentrations outside the Geyers area have remained very low.

GEOTHERMAL POWER PLANTS

POWER PLANT SYSTEMS AND COMPONENTS

25684 (TID—27071) **National geothermal test facility.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1976. 11p. Dep. NTIS $3.50.

A brief description of the East Mesa test site is given. The test facility is supplied by brines from three of the existing production wells, each brine having distinctive physical characteristics. Some of the experimental programs involving heat exchangers and power cycles are briefly discussed. These include binary fluid cycles, two-phase expansion cycles, and combination cycles. (MOW)

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 26660

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 25684

25685 (UCRL—52000-76-3, pp 1-6) **Advanced energy systems: control of geothermal scaling and corrosion.** Mar 1976.

In Energy and technology review: geothermal brine studies.

A major goal of the LLL geothermal project is development of the total-flow concept for converting the thermal energy of high-temperature, high-salinity brines to electric power. A series of field experiments leading to demonstration of this concept's feasibility will be conducted during the next three years at the Salton Sea geothermal area in Southern California. Initial experiments, covering the next six months, will concentrate on evaluating brine modification procedures for preventing scale deposition, together with preliminary materials testing. Later field work will emphasize advanced materials testing, control of suspended solids, conversion equipment performance, and brine reinjection methods. This article describes the initial experimental program and our field test rig at the Salton Sea.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

REFER ALSO TO CITATION(S) 26660

DIRECT ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 25679

OTHER

REFER ALSO TO CITATION(S) 26668

WIND ENERGY

REFER ALSO TO CITATION(S) 25988

WIND ENERGY ENGINEERING

APPLICATIONS

REFER ALSO TO CITATION(S) 25618, 25620

TURBINE DESIGN AND OPERATION

25686 (SAND—76-0130) **Wind tunnel performance data for the Darrieus wind turbine with NACA 0012 blades.** Blackwell, B.F.; Sheldahl, R.E.; Feltz, L.V. (Sandia Labs., Albuquerque, N.Mex. (USA)). May 1976. Contract AT(29-1)-789. 61p. Dep. NTIS $4.50.

Five blade configurations of a 2-meter-diameter Darrieus wind turbine have been tested in the LTV Aerospace Corporation 4.6- x 6.1-m (15- x 20-ft) Low Speed Wind Tunnel. The airfoil section for all configurations was NACA 0012. The parameters measured were torque, rotational speed, and tunnel conditions. Data are presented in the form of power coefficient as a function of tip-speed ratio for the various solidities, Reynolds number, and freestream velocities tested.

25687 (SAND—76-5535) **Low-cost blade design considerations.** Feltz, L.V. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 38p. (CONF-760551—1). Dep. NTIS $4.00.

From Vertical-axis wind turbine technology workshop; Albuquerque, New Mexico, United States of America (USA) (17 May 1976).

The studies described attempt to identify and continually upgrade blade designs for a 17 meter wind turbine design. The goal of this effort is to establish several low-cost blade designs.

25688 (SAND—76-5683) **Status of the ERDA/Sandia 17-METRE Darrieus turbine design.** Blackwell, B.F. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. Contract AT(29-1)-789. 16p. (CONF-760909—2). Dep. NTIS $3.50.

From International symposium on wind energy systems; Cambridge, United Kingdom of Great Britain and Northern Ireland (UK) (7 Sep 1976).

The present status of the ERDA/Sandia Laboratories 17-metre Darrieus turbine design is summarized.

25689 (SAND—76-5712) **Darrieus Vertical-Axis Wind Turbine Program at Sandia Laboratories.** Kadlec, E.G. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. Contract AT(29-1)-789. 11p. (CONF-760821—7). Dep. NTIS $3.50.

From Sharing the sun, solar technology in the seventies; Winnipeg, Canada (15 Aug 1976).

As part of ERDA's Federal Wind Energy Program, Sandia Laboratories is engaged in a technology development program for the Darrieus Vertical Axis Wind Turbine (VAWT). The application receiving current emphasis utilizes the VAWT operating at constant speed to generate electricity which is fed directly into a utility grid. The activities within the program are described.

25690 **Preliminary investigation of the Darrieus wind turbine.** Strickland, J.H.; Ford, S.R.; Reddy, C.B. (Texas Tech. Univ., Lubbock). pp 633-643 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

This paper describes work which is presently in progress at Texas Tech University concerning the characteristics of the vertical axis Darrieus wind turbine. A computer model which is capable of predicting the steady-state performance of the Darrieus rotor has been developed and is presently being extended to include transient behavior as well as behavior in spatially nonuniform winds. A 14-ft. diameter two-bladed Darrieus rotor has been constructed and installed on flat, open terrain. This rotor was instrumented such that the energy extraction rate as a function of wind speed and rotor speed could be measured and controlled. Various aspects of the design and operation of this system are discussed along with analytical and experimental performance results.

25691 **Wind driven power generator.** Taminini, R.J. US Patent 3,924,966. 9 Dec 1975. Filed date 25 Sep 1974. 4p.

A rotor body is provided including a generally cylindrical side wall open at its opposite ends and supported for rotation about an axis generally coinciding with the center axis of the body. The body includes a plurality of circumferentially spaced longitudinally extending slots similarly slightly inclined relative to radial planes passing through the slots and the edge portions of the cylindrical side wall defining corresponding longitudinal edges of the slots include inwardly projecting vanes inclined at least thirty degrees relative to planes tangent to the cylindrical side wall edges inwardly from which the vanes extend.

25692 **Apparatus for extracting energy from winds at significant height above the surface.** Lois, L. US Patent 3,924,827. 9 Dec 1975. Filed date 25 Apr 1975. 8p.

A bouyant wing is tethered to a line an appreciable distance above the surface where the winds are at higher speed than at ground level. The other end of the line(s) is attached, for example, to an electrical generator, and provision is made for adjusting the position of the wing so that when a series of wings are utilized together with an electrical generator, one wing may be retracted while at least one other wing which is positioned to catch the wind is drawn away from the generator.

POWER CONVERSION SYSTEMS

25693 **Heating and cooling system.** Fields, J.C. Jr. US Patent 3,956,902. 25 Mar 1975. vp.

A system for heating and cooling an enclosure is described which comprises: first energy converting means for converting wind energy to mechanical energy; second energy converting means associated with the first converting means and adapted to convert the mechanical energy to varying amounts of electrical energy in proportion to the amount of the wind energy for use in the heating and cooling system; and thermoelectric heating and cooling means comprising a plurality of parallel connected thermoelectric devices connected to the second energy converting means for converting the electrical energy to thermal energy, the thermal energy being employed to heat and cool the interior of the enclosure.

ELECTRIC POWER ENGINEERING

POWER GENERATION

REFER ALSO TO CITATION(S) 25242, 25540, 25703, 25972, 25975

25694 **Predicting performance of a coal-fired air-blown gasifier.** Sage, W.L. (Babcock and Wilcox Research and Development Center, Alliance, OH). *Am. Chem. Soc., Div. Fuel Chem., Prepr.*; **18**: No. 2, 211-220(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

Future projections of energy sources to meet the needs for electric power generation predict that coal will be a major fuel source. However, government-imposed limitations on emission levels of particulates, sulfur and nitrogen oxides make compliance by conventional coal fired units almost impossible. Alternate approaches which are currently receiving considerable attention employ air-blown coal gasification and gas cleaning followed by second stage burning. Paramount in the design of such cycles is the ability to accurately predict the product gas quality exiting from the coal gasifier. Operational data from a 5000 sctm atmospheric pressure air-blown suspension type slagging coal fired gasifier are presented. A correlation of these data shows this process is kinetically controlled and that the product gas heating value (Btu/scf) can be predicted using on a term defined as heat available (Btu/lb air imput) which is a function of (1) coal analysis, (2) air preheat, (3) char recycle rate, and (4) heat losses.

COOLING SYSTEMS

REFER ALSO TO CITATION(S) 25845, 25846

25695 (AD-A—010432) **An analytical method for determining heat transfer from power plant coolant in the Florida 'Boulder Zone'. Final report.** Greenberg, M.; Van den Berg, A.J. (Army Facilities Engineering Support Agency, Fort Belvoir, Va. (USA). Research and Technology Div.). Jul 1974. 43p. (RT—2000). NTIS $3.75.

An analytical solution to the heat transfer problem of dissipating the heat from 83F power plant coolant to 60F rock and sea water is presented. The problem considers the concept of injecting the coolant into the 'Boulder Zone,' the cavernous geological strata underlying all of South Florida, allowing a fresh water 'bubble' to form, and cool for 30 days, before being recirculated back to the plant. The solution revealed that the average temperature of the 'bubble' would be 68.3F with approximately 37% of the total water discharged at 61F and 17% at 83F. The remaining water, or approximately 46% would be a mixture at about 73.5F. (GRA)

25696 (BNWL—2060) **Scale formation in deluged dry cooling systems.** Pratt, D.R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1976. Contract E(45-1)-1830. 50p. Dep. NTIS $4.00.

Deluging of air-cooled heat exchangers with water during warm periods holds the promise of increasing heat rejection capability and reducing the cost of dry cooling. One of the principal uncertainties in the use of the deluge concept is the tendency toward deposition of solids from the delugate. Small amounts of calcium carbonate scale may significantly reduce the cooling efficiency of a deluged system by reducing the heat transfer coefficient and interfering with delugate flow. Thus the question of delugate water quality is of major importance in evaluating scale formation and its effect on heat transfer in the deluged dry cooling system. The paper discusses, in relation to the deluged dry cooling system, the importance of scale prevention, the theory of scale formation and application of this theory to the deluged system, the problems of delugate evaporation, and delugate treatment required to prevent scaling.

25697 (COO—2381-1) **Fabrication and procurement of equipment, for the period 1 September 1973—30 June 1974. Final report. Phase II.** Carlson, T.B. (Environmental Systems Corp., Knoxville, Tenn. (USA)). 3 Sep 1974. Contract 5-73-04(74). 38p. Dep. NTIS $4.00.

A description is given of instrumentation that will be used to characterize the effluents from the Chalk Point Unit No. 3 cooling tower. Operational characteristics are summarized for each of the parameters that will be measured.

COMBINED AND BINARY CYCLES

REFER ALSO TO CITATION(S) 25231, 25236, 25297, 25998

25698 (PB—241463) **Reduction of NO/sub x/ through staged combustion in combined cycle supplemental boilers. Volume I. Systems optimization analyses. Final report.** (KVB Engineering, Inc., Tustin, Calif. (USA)). Feb 1975. 79p. NTIS $4.75.

See also Volume 21, PB—241464.

An investigation directed to control of emissions from supplemental-fired combined cycles with the use of staged combustion in the steam generating portion of the system is discussed. A combined cycle, as considered in this report, is the assembly of any number of gas turbines, steam generators, and steam turbines for electric power generation in which the exhaust of the gas turbines is passed through the steam generators. A supplementary-fired combined cycle employs combustion of fuel in the gas turbine exhaust to increase temperatures in the steam system. Staged combustion is achieved by the separation of the exhaust from the gas turbines into two streams prior to entering the steam generator with provisions for primary combustion of fuel in one stream with a deficiency of air. Combustion is completed in a secondary stage by mixing the unfired stream into the products of the fired stream. The use of staged combustion provides conditions favorable for the occurrence of chemical reactions that result in a reduction of mass flow of nitric oxide (NO) present in the gas turbine exhaust. Volume I is concerned with the engineering analysis of combined cycle performance and NO/sub x/ reduction potential. (GRA)

25699 (PB—241464) **Reduction of NO/sub x/ through staged combustion in combined cycle supplemental boilers. Volume II. Experimental program. Final report.** (KVB Engineering, Inc., Tustin, Calif. (USA)). Feb 1975. 101p. NTIS $4.75.

See also Volume I, PB—241463.

The experimental program and results of an investigation of staged combustion in combined cycle (steam-gas turbine) electric power generation for the reduction of NO/sub x/ in the exhaust gases is described. Several burner configurations were tested, and various flow schemes and air fuel ratios were used.

25700 (UCRL—77905) **Topping cycle for coal-fueled electric power plants using the ceramic helical expander.** Myers, B.; Landingham, R.; Mohr, P.; Taylor, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 May 1976. Contract W-7405-Eng-48. 29p. (CONF-751119—3). Dep. NTIS $4.00.

From Symposium on environment and energy conservation; Denver, Colorado, USA (3 Nov 1975).

Ceramic helical expanders are advocated as the work output element in a 2500°F direct coal-fired Brayton topping cycle for central power station application. When combined with a standard steam electric power plant cycle, such a cycle could result in an overall thermal conversion efficiency in excess of 50 percent. The performance, coal tolerance, and system-development-time advantages of the ceramic helical expander approach are enumerated. A perspective on the choice of design and materials is provided. A preliminary consideration of physical properties, economic questions, and service experience has led us to a preference for the silicon nitride and silicon carbide family of materials. A program to confirm the performance and coal tolerance aspects of a ceramic helical expander system is planned.

SOLID-WASTE INCINERATION

REFER ALSO TO CITATION(S) 25541, 26358, 26359

POWER PLANT COMPONENTS

25701 (ERDA-tr—141) **Ensuring the reliability of boiler aggregates of SKD (super critical pressure) blocks during operaton at slipping pressure.** Rudyka, A.V.; Safonov, A.G. 1968. Translation of Obespechenie nedezhnosti kotel'nykh agregatov blokov SKD pri rabote na skol'zyashchem davlenii. 13p. Dep. NTIS $3.50.

An investigation of the thermodynamic process occurring in a powdered coal-fired boiler operated at supercritical and subcritical pressures was performed to establish criteria of the reliability of the steam generating heating surfaces. It was concluded that supercritical pressure boilers should ensure operation of the installations in a pressure range of 30 to 100 percent of the nominal and with pressures of steam ahead of the turbine of 100 to 250 kgf/cm². If criteria of reliability for the boiler heating surfaces during operation on slipping pressure are the change and hydraulic characteristics, as well as the temperature misalignments caused by unequal supply of the steam-water mixture through the tubes, then the minimum pressure in the steam generating zone of the boiler should be within the limits of 100 to 140 kgf/cm². Under these conditions, vertical sheets with upward movement of the medium, horizontal-upward sheets with coils throughout the entire width of the furnace and vertical lift-release sheets with a minimum number of passages and an increment of medium enthalpy of no more than 100 kcal/kg, will have adequate reliability. (LCL)

25702 **Off-shore power plant.** Schiemichen, P. (to Deutsche Babcock and Wilcox Aktiengesellschaft). US Patent 3,962,877. 15 Jun 1976. Priority date 16 Mar 1974, German, Federal Republic of (F.R. Germany). 4p.

An off-shore power plant in which the steam generators of the power plant are located within the support structure carrying the components of the power plant is described. The steam generator is operated with superpressure in the combustion chamber. A gas turbine is connected to the flue gas smoke stack of the combustion chamber, and a steam turbine is connected to the steam duct of the chamber. The support structure holding the steam generator carries a platform with several decks. The water treatment and gas purification equipment is located on the lower deck, whereas the upper deck carries the turbines and the generators.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 25910

ECONOMICS

REFER ALSO TO CITATION(S) 25241, 25974, 25992

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 25240, 26010, 26469, 26506, 26508

25703 **Advanced COGAS power systems for low pollution emissions.** Giramonti, A.J. (United Aircraft Research Labs., Hartford). *Am. Chem. Soc., Div. Fuel Chem., Prepr.;* **18**: No. 2, 195-210(1976).

From 165. meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

See CONF-730403—P2.

Analytical studies have been conducted to define commercially feasible, advanced-technology central power stations which would eliminate or significantly reduce utility-caused atmospheric pollution and thermal water pollution. The basic concept investigated represents a combination of (1) advanced cycle, COmbined Gas And Steam (COGAS) turbine electric power generation systems based on technology spinoff from the aircraft gas turbine industry, and (2) selected processes for deriving nonpolluting gaseous fuel from high-sulfur residual fuel oil. The results of these studies clearly indicate that advanced COGAS power systems integrated with fuel gasification systems would be more effective than future fossil steam systems in controlling emissions of ash, sulfur oxides, and waste heat. In addition, preliminary calculations indicate that emissions of nitrogen oxides could be reduced up to several orders of magnitude by using low-Btu gasified fuel compared with emissions caused by the combustion of high-Btu fuels. It appears that advanced gas turbine and COGAS power systems using low-Btu fuels could be fired to higher turbine inlet temperature to improve performance and still emit significantly fewer nitrogen oxides than when operating at low turbine inlet temperature with high-Btu fuels. Furthermore, prospective COGAS systems could produce electricity at lower cost than could be producedby alternative fossil steam systems with comparable air and water pollution controls. Also, despite the relatively high cost of fossil fuels, advanced COGAS power systems should offer a viable alternative to nuclear power systems for future base-load power generation.

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 26556

NOXIOUS GAS CONTROL

REFER ALSO TO CITATION(S) 25279

25704 (PB—234150) **Collaborative study of method for the determination of particulate matter emissions from stationary sources (fossil fuel-fired steam generators). Final report.** Hamil, H.F.; Thomas, R.E. (Southwest Research Inst., San Antonio, Tex. (USA)). 30 Jun 1974. 40p. (EPA—650/4-74-021; SwRI—01-3487-01). NTIS.

Method 5, a test procedure for determining particulate emissions specified in the Environmental Protection Agency's Standards of Performance of New Stationary Sources, was tested, and results are presented. Method 5 specifies that particulate matter be withdrawn isokinetically from the source and its weight be determined gravimetrically after the removal of uncombined water. The test was conducted at a fossil fuel-fired steam generating power plant using four collaborating laboratories. Sixteen sample runs were made over a 2-week period by the collaborators for a total of 63 individual determinations. The reported values of one of the laboratories were not included in the analysis because the determinations were not representative of Method 5 results. Of the remaining determinations, one was eliminated due to failure to maintain isokinetic conditions. The remaining values were subjected to statistical analysis to estimate the precision that can be expected with field usage of Method 5. The estimated within-laboratory standard deviation was 31.1 percent of the mean standard deviation determination with 34 degrees of freedom; the estimated between-laboratory standard deviation was 36.7 percent with two degrees of freedom; the laboratory bias standard deviation was 19.5 percent. The precision estimates reflected operator and source variability. The results were obtained from a single test using data from three collaborators.

25705 (PB—235751) **Exhaust emissions from uncontrolled vehicles and related equipment using internal combustion engines. Part 6. Gas turbine electric utility power plants. Final report.** Hare, C.T.; Springer, K.J. (Southwest Research Inst., San Antonio, Tex. (USA)). Feb 1974. 40p. (APTD—1495; AR—940). NTIS.

Emissions data derived from laboratory and field test findings reported in the literature are sumarized for gas turbine electric utility power plants. The data are utilized together with information on the location and population of the plants to estimate national emissions impact, based on usage as reported to the Federal Power Commission. Expressing emissions from electric utility turbines as percentages of 1970 national totals from all sources, they account for approximately 0.6 percent of the nitrogen oxides, 0.05 percent of the hydrocarbons, 0.04 percent of the carbon monoxide, 0.03 percent of the particulates, and 0.02 percent of the sulfur oxides. Although overall emissions from electric utility turbines are not a large percentage of total emissions, they do occur in urban and suburban areas where they have high potential to affect people. These emissions probably occur during afternoon pollution peak hours and during the summer when other air pollution problems may be severe. The potential growth of turbine usage for power generation is quite substantial, although the Federal Power Commission estimates that the fraction of total electric power generated by turbines will probably not increase substantially in the near term.

25706 (UCRL—77669) **Trace-element emissions from western U.S. coal-fired power plants.** Ragaini, R.C.; Ondov, J.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jul 1976. Contract W-7405-Eng-48. 11p. (CONF-760915—1). Dep. NTIS $3.50.

From Modern trend in activation analysis; Munich, German, Federal Republic of (F.R. Germany) (13 Sep 1976).

It is shown that the particle-size distributions of trace elements in stack emissions are significantly different for two power plants, and also for two different emission control systems at the same power plant. The particle-size distributions are governed by the elemental volatility characteristics and the emission control systems. Generalizations are not valid in determining the potential inhalation effects from coal-fired power plants; the particular stack emissions of interest must be examined. Comparison of pulmonary deposition of several toxic particulate species from the two devices suggests that use of Venturi scrubbers as opposed to electrostatic precipitators for particulate emission control may result in increased potential for pulmonary exposure.

25707 **Fly ash pioneers a reclamation economy as energy/resource challenges confront engineering community.** Faber, J.H. (National Ash Association, Inc., Washington, DC). *Prof. Eng.*; **44**: No. 7, 18-22(Jul 1974).

A nontechnical review of present and future uses of ash is presented. Presently only 16 percent of the total ash production is being put to use, but utilization will become greater as efforts for recycling broaden. Research is developing many new and exciting uses for the ash remaining after the burning of coal.

25708 **Process for treatment of waste gases.** Aibe, T.; Mochida, S.; Itoga, K. (to Takeda Chemical Industries, Ltd.). US Patent 3,926,590. 16 Dec 1975. Priority date 24 Oct 1972, Japan. 8p.

Waste gas containing sulfur oxide and/or nitrogen oxide is allowed to contact with activated carbon which is previously treated with ammonia at an elevated temperature, whereby sulfur oxide and/or nitrogen oxide are removed from the gas.

25709 **Foam scrubber.** Huppke, G.P. (to Environeering, Inc.). US Patent 3,963,463. 15 Jun 1976. Filed date 17 Apr 1972. 14p.

A foam scrubber for removing contaminants from gas comprising first means for entrapping small, discrete volumes of said gas within liquid film enclosures comprising a mass of foam bubbles. Means for maintaining said foam bubbles a selected maximum size and for a selected interval of soaking time permitting the contaminants within the bubbles to diffuse and become entrapped within the surrounding liquid film of the bubbles. Means for collapsing the foam bubbles after the soaking period and separating the contaminant containing liquid thereof from the cleansed gas.

25710 **Recovery of elemental sulfur from sulfur dioxide bearing waste gases.** Witte, M.; Mehta, M.S. (to U.S. Filter Corp.). US Patent 3,969,492. 13 Jul 1976. Filed date 29 Oct 1973. 8p.

A process is described for effecting the selective removal of sulfur dioxide values from industrial waste gases or the like and conversion thereof to elemental sulfur wherein a particularly constituted solution of mixed ammonium phosphates is exposed to absorbent contact with the sulfur dioxide bearing gas stream followed by recovery of the sulfur values therefrom and regeneration of the absorbent solution preparatory to reexposure thereof to the sulfur dioxide bearing gas stream.

25711 **Cyclonic gas scrubbing system.** Murray, D.N. Jr. (to Hammermill Paper Co.). US Patent 3,969,093. 13 Jul 1976. Filed date 5 Nov 1974. 8p.

A cyclonic gas cleaning system is described having an elongated rotary spray header mounted centrally of an elongated housing coextensive therewith. Gas circulates helically upward within the housing while the spray header rotates and sprays a scrubbing fluid into the gas.

25712 **Flue gas scrubber.** Dunson, J.B. Jr.; Lucas, R.L. (to E. I. Du Pont de Nemours and Co.). US Patent 3,969,094. 13 Jul 1976. Filed date 11 Dec 1973. 10p.

Baffle tray columns can be designed and operated so as to function as highly efficient scrubbers for the cleaning of flue gases subject to wide variations in flow. The columns are designed and operated such that areas within the scrubbing area operate with a liquid phase continuous froth as the contacting medium. The columns can also contain an integral non-clogging separator for entrainment control.

SITE SELECTION

REFER ALSO TO CITATION(S) 25702

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 25977

25713 (INIS-mf—3023) **STUDSGRID: simple simulator model of the Swedish power grid.** Karlsson, R. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 23 Apr 1975. 11p. (In Swedish). (CONF-7505117—1). INIS.

From Scandinavian Simulator Association annual meeting; Risoe, Denmark (12 May 1975).

The grid model comprises two equivalent synchronous machines, one with stamped poles representing North Sweden and one with a round rotor for South Sweden, plus a machine representing an atomic power station. The generators are coupled to a grid with representative impedances and loads. STUDSGRID is primarily intended to operate together with the existing simulator models for atomic power stations, STUDS-1 and -2, but the connections with these are not yet carried out. The report gives a general description of the model, its construction and scope, as well as a survey of the calculation and simulation methods used.

25714 (PB—241314) **Response of power systems to the San Fernando Valley earthquake of 9 February 1971. Final report.** Schiff, A.J.; Yao, J.T.P. (Purdue Univ., Lafayette, Ind. (USA). Center for Large Scale Systems). Jan 1972. 89p. NTIS $4.75.

The impact of the San Fernando Valley earthquake on electric power systems is discussed. Particular attention focused on the following three areas; (1) the effects of an earthquake on the power network in the Western States, (2) the failure of subsystems and components of the power system, and (3) the loss of power to hospitals. The report includes sections on the description and functions of major components of a power network, existing procedures to protect the network, safety devices within the system which influence the network, a summary of the effects of the San Fernando Valley earthquake on the Western States Power Network, and present efforts to reduce the network vulnerability to faults. Also included in the report are a review of design procedures and practices prior to the San Fernando Valley earthquake and descriptions of types of damage to electrical equipment, dynamic analysis of equipment failures, equipment surviving the San Fernando Valley earthquake and new seismic design specifications. In addition, some observations and insights gained during the study, which are not directly related to power systems are discussed.

25715 (PB—241666) **Application of security indices and restraints to a real power system. Interim report on Phase A.** (International Business Machines Corp., Houston, Tex. (USA)). Feb 1974. 237p. NTIS $7.50.

Prepared in cooperation with Southern Services, Inc. See also report on Phase B, PB—241855 and PB—241668.

The progress to date mainly has involved the specification and acquisition of data on the Mississippi Power Co. system; development and testing of the applications programs; and design of the on-line security monitor. This has included the state estimator with load determination, the steady state equivalent, the contingency load flow, the index calculations, and the CP/67 version of the security monitor. The work on the applications programs was accomplished using the data on the Mississippi Power Co. system, and on the Southern Services Inc. system.

25716 (PB—241855) **Application of security indices and restraints to a real power system. Interim report on Phase B.** (International Business Machines Corp., Houston, Tex. (USA)). Oct 1974. 39p. NTIS $3.75.

Prepared in cooperation with Southern Services, Inc. See also report on Phase A, PB—241666.

The major objective of Phase B has been to implement a Security Index Monitor System (SIMS) at Southern Services, Inc. Power Coordination Center. This system has been designed to combine 'real time' measurements from the Mississippi Power Co. remote substations with engineering data stored in disk-resident arrays to create a 'Study Data Base.' This is used in the analysis of the effect of user contingencies imposed on the network represented by this data base. The system has been designed to provide the power system coordinator with a means of interacting with the SIMS through CRT displays and keyboard. The SIMS processing can be divided into four functional areas: initialization, interactive display processing, computational processing, and report display processing.

AC SYSTEMS, EHV AND UHV

25717 (ORNL-tr—4182) **N_2—SF_6 gas mixture as insulation material for high voltage technology.** Ermel, M. Translated by E.G. Silver from *Elektrotech. Z., A;* **96**: No. 5, 231-235(1975). 18p. Dep. NTIS $3.50.

Breakdown strength in the uniform and nonuniform field, vapor pressure curves and chemical stability under spark discharges are examined. Moreover, considerations are made to the theory of breakdown in gas mixtures. The investigation of breakdown characteristics leads to a general statement about the electric strength of the N_2-SF_6-mixture. Even an important reduction of SF_6-content causes only low loss of strength compared to SF_6, at the same time preventing SF_6-condensation in a wider range. Altogether the mixture shows some advantages compared to SF_6. As a result of the theoretical considerations modified ionization coefficients for gas mixtures are introduced and explained for the N_2-SF_6-mixture.

DC SYSTEMS

25718 (ORNL-tr—4185) **SF_6 breakdown in cylindrical field under dc voltage.** Ermel, M. Translated by E.G. Silver from *Elektrotech. Z., A;* **96**: No. 11, 505-510(1975). 16p. Dep. NTIS $3.50.

Investigations were made in a coaxial cylinder system at high dc-voltages up to 900 kV and at high gas pressures up to 6 bar. The SF_6-breakdown-behavior can be classified into three regions according to the following aspects: (1) breakdown after steady corona discharges, (2) validity of the similarity law for the discharge onset voltage, and (3) deviations of the similarity law with a marked polarity effect. Possible explanations are given for the polarity effect and the deviations in region 3. The results can be of importance for a future application of SF_6-insulation in HVDC systems.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

25719 (COO—2552-5) **Assessment and study of existing concepts and methods of cryogenic refrigeration for superconducting transmission cables. Progress report, 1 November 1975—31 December 1975.** Kadi, F.J.; Longsworth, R.C. (Air Products and Chemicals, Inc., Allentown, Pa. (USA)). 1976. Contract E(11-1)-2552. 25p. Dep. NTIS $3.50.

Progress in research on cryogenic refrigeration systems for use with 345 kV superconducting transmission cables is reported. Information is included on component reliability and efficiency, development of optimization criteria, and evaluation of effects of redundancy and back-up on overall system reliability. (LCL)

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 25713, 25923, 25926, 25941, 25975, 25987

25720 (INIS-mf—3025, pp 10p, Paper NS(75)1.4) **Efforts for maintaining a high quality level in operating atomic power plants.** Bergstroem, J. 1975. (In Swedish).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25721 (INIS-mf—3025, pp 1p, Paper NS(75)2.7) **The organisation and work of the authorities: a contribution to the discussion.** Boehler, T. 1975. (In Norwegian).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25722 (INIS-mf—3025, pp 17p, Paper NS(75)1.5) **Quality assurance and quality control.** Kaden, W.; Pahnke, R. 1975.

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Title of abstract: German quality assurance system for nuclear power stations. Practice, experiences, tendencies.

In Nuclear power plants quality assurance.

25723 (INIS-mf—3025, pp 1p, Paper NS(75)4.2) **Quality assurance in the U.S. nuclear power industry.** Morris, P.A. 1975.

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).
Published in summary form only.
In Nuclear power plants quality assurance.

25724 (INIS-mf—3025, pp 6p, Paper NS(75)2.6) **The attitude of the power producers towards the work of the authorities.** Regnell, B.; Nurmimaeki, K.; Karling, K. 1975. (In Swedish).
From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).
Published in summary form only.
In Nuclear power plants quality assurance.

25725 (INIS-mf—3025, pp 3p, Paper NS(75)3.5) **Planning and implementation of external audit.** Tusa, J. 1975. (In Swedish).
From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).
Published in summary form only.
In Nuclear power plants quality assurance.

25726 (INIS-mf—3025) **Nuclear power plants quality assurance. 3. Nordic seminar, Elsinore, Denmark, 3—5 December 1975. Abstracts.** Kaiser, N.E. (ed.). (Nordisk Kontaktorgan for Atomenergispoergsmaal, Risoe (Denmark)). 1975. 316p. (CONF-751239—(Absts.)). INIS.
From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).
Summaries are presented for papers on quality assurance aspects of nuclear power plant construction and operation. Each summary is cited separately for ERA. (HDR)

25727 (INIS-mf—3047) **Problems associated with nuclear energy utilization in developing countries.** Aybers, N. (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy). 1975. 42p. INIS.
The special problems of integrating nuclear power into the overall national power system of a developing country are reviewed. Topics such as optimal size selection, policy for nuclear fuel cycle, and choice of reactor type are examined. The results of these analyses as applied to Turkey are presented. The impact of safety and regulatory matters are discussed.

25728 (JAERI-M—5955) **Reactor Engineering Division annual report. April 1, 1973 to March 31, 1974.** (Japan Atomic Energy Research Inst., Tokyo). Feb 1975. 200p. INIS.
This report summarizes main research achievements in the 48th fiscal year which were made by Reactor Engineering Division consisted of eight laboratories and Computing Center. The major research and development projects, with which the research programmes in the Division are associated, are development of High Temperature Gas Cooled Reactor for multi-purpose use, development of Liquid Metal Fast Breeder Reactor conducted by Power Reactor and Nuclear Fuel Development Corporation, and Engineering Research Programme for Thermonuclear Fusion Reactor. Many achievements are reported in various research items such as nuclear data and group constants, theoretical method and code development, integral experiment and analysis, shielding, heat transfer and fluid dynamics, reactor and nuclear instrumentation, dynamics analysis and control method development, fusion reactor technology and activities of Computing Center.

25729 **Nuclear energy development in Europe.** Banal, M. (Electricite de France, 75 - Paris). *Rev. Fr. Electr.;* **48**: No. 249, 21-25(1975). (In French).
The present state of the nuclear development in Europe is discussed. Power plants already operating and those presently being built or to be put in operation before 1980 are considered. Only the large industrial countries near France are dealt with. A table gives the whole electric power production and its nuclear component for the more important industrial countries in 1974. Te respective powers of the power plants operating on January 1, 1975 and those that must be in operation in 1980 and 1985, in France, the U.K., Germany, Spain, Italy, Sweden and Belgium are successively considered.

25730 **White paper on atomic energy, for 1974 and 1975.** *Genshiryoku Hakusho;* No. 1974-1975, 1-187(Sep 1975). (In Japanese).
Nearly 20 years have passed since the initiation of peaceful uses of atomic energy in Japan. Close to the end of this period, there occurred the so-called oil crisis, which emphasized the need for nuclear power development. Meanwhile, voices of the people in Japan are varied concerning nuclear power, as in siting of the power plants and the n.s. (nuclear ship) Mutsu. The paper describes the following: safety, environmental protection, nuclear power generation, nuclear fuel cycle, fission reactor and fusion reactor development, nuclear-powered ships, and radiation utilization.

25731 **South Africa's nuclear power programme.** Colley, J.R. (Electricity Supply Commission, Johannesburg (South Africa)). *Energy (Oxford);* **2**: No. 1, 12-22(Feb 1976).
Extracted from a paper presented to the South African Institution of Mechanical Engineers.
Economic studies of nuclear power possibilities in South Africa were carried out in 1966 and subsequently up-dated several times, culminating in a decision by ESCOM in February, 1974 to issue an enquiry for two units of up to 1 000 MW each at Koeberg in the W. Cape. After an evaluation of all available types of power reactors ESCOM decided to confine the tendering to the pressurised and boiling water systems only. An outline description is given of each system. The site for Koeberg and the site investigations being undertaken by ESCOM are described; particular emphasis is being devoted to safety and ecological aspects. The programme for Koeberg is given and possible future nuclear power development in South Africa is described.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 25417, 25778, 25797, 25870, 25877, 25878, 25881, 25883, 25884, 25885, 25888

25732 (BNL—50497) **Intergranular stress corrosion cracking of sensitized stainless steels. Quarterly progress report, October 1—December 31, 1975.** (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. Contract E(30-1)-16. 29p. Dep. NTIS $4.00.
Research and testing programs to study the initiation and growth of intergranular stress corrosion cracking in BWR stainless steel piping are described. Information is presented concerning mechanisms of crack propagation, mechanisms of crack initiation, methods for measuring intergranular corrosion rates, and reference electrode scanning of metal surfaces. 15 references.

25733 (IAEA-R—1119-F) **Collection of gamma spectra data of irradiated light water moderated reactor spent fuel and study of the applicability of the methods for fuel identification. Final report for the period 1 February 1972—October 1975.** Natsume, H.; Matsuura, S.; Okashita, H.; Umezawa, H.; Ezure, H. (International Atomic Energy Agency, Vienna (Austria)). Oct 1975. 97p. INIS.
The gamma spectrometric data are obtained non-destructively on 96 points of a spent fuel assembly of the JPDR-1 by using an on-site gamma scanning facility in the fuel storage pond. Destructive gamma spectrometric, alpha spectrometric, chemical and mass spectrometric analyses are also performed for uranium, transuranium elements and some fission products on the selected 24 samples among the 96 non-destructively measured points. The feasibility of the non-destructive measurements is examined by comparing those results with the results of destructive analyses. Isotopic ratios of various combinations of fission products or heavy nuclides are studied in relation to burn-up and Pu/U ratios. The results show that the relationships are affected by reactor characteristics of BWR and the operation history. The applicability of the isotopic correlations technique is discussed from the standpoint of analysing reactor characteristics and applying them to safeguarding of nuclear materials.

25734 (INIS-mf—3025, pp 5p, Paper NS(75)1.3) **Implemtation of quality assurance for the construction work for the containment of the TVO II reactor.** Eerola, T.; Tusa, J. 1975. (In Swedish).
From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).
Published in summary form only.
In Nuclear power plants quality assurance.

25735 (JAERI-M—5987) **Design data and safety features of commercial nuclear power plants in the United States: thermal hydraulic.** Kuriyama, M.; Morishima, A. (Japan Atomic Energy Research Inst., Tokyo). Feb 1975. 38p. (In Japanese). INIS.
The thermal-hydraulic data of commercial nuclear power plants in the United States are presented for 85 PWRs and 52 BWRs. Covered are the temperature, pressure, heat flux, flow rate, etc. of coolant and/or fuel cladding; the definitions are also given for some of these items.

25736 (KURRI-TR—123, pp 37-39) **Failed fuel detection in BWR.** Sasaki, S.; Koreki, S. 1974. (In Japanese).
From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

Two types of method to detect failed fuel are available during Open Vessel period in BWR. One is in core sipping method. A wet-sample apparatus is used to sip water from the individual fuel assemblies within a control rod cell. The upward water flow is blocked by placing the wet-sample apparatus on the upper grid and displacing some of the water within the apparatus by air pressure, thus forming an air cushion. Soak period is used to permit the concentration of fission products in the stagnated water surrounding the fuel assemblies to be sampled. Samples are sipped and transferred to the hot laboratory for chemical analysis. Each sample is passed through an anion exchange resin to separate the iodine. Radioactivity of the separated iodine resin sample is counted using NaI(Tl) crystal connected to pulse height analyzer. Signal to Background ratio of Iodine determines which fuel assemblies are defective. The other is Out of Core sipping method. Special sipper Can is installed in the spent fuel pool. This can holds one fuel assembly transferred from reactor core. Sipper head is set on the can and isolate the bundle completely from water in the pool. The water in the Can is purged and displaced with demineralized water. The procedure after soaking is same as the incore sipping procedure.

25737 (KURRI-TR—123, pp 46-57) **Detection of failed fuels at JPDR.** Ishizuka, M. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

Three failed fuel assemblies were successfully detected at JPDR in the years 1964-67. The first failure was noticed clearly by the sudden increase of off-gas monitor indication, but, with already existing failure, the occurrence of the second and third was not detectable. Locallization of control rod cells containing failed assemblies was performed during power operation period by means of flux tilting method. After shutdown and with the pressure vessel head off, water was sampled from inside of each fuel assembly belonging to the suspected cells. Analysis of the sampled water for I, Cs and Xe minimized the area of suspicion. The final confirmation was done by isolating the suspected assemblies in a closed container placed in the fuel pool and analyzing I and Cs concentrations in the container water.

25738 **Optimal refueling pattern design for light water reactors.** Chen, F.Y.F. Manhattan, KS; Kansas State Univ. (1975). 96p. University Microfilms Order No. 76-17,110.

Thesis (Ph. D.).

A method is developed to determine a refueling loading pattern of light water reactors for the purpose of minimizing power peaking ratio. Results show that this method is capable of consistently producing a satisfactory loading pattern under various refueling policies with significant savings of computing time in comparison with other methods. The key points of this method are that the highest reactivity fuel assemblies are always placed into the peripheral region of the reactor and the rest of the assemblies are further divided into two groups based on their neutronic characteristics. These assemblies are loaded into the reactor in a checkerboard pattern. The method is simple compared with other methods in terms of the overall formulation and its applicability. Initial guess of loading pattern is not required, nor does it need any shuffling logic. A cost analysis was performed. The results showed that the use of this algorithm could lower the overall fuel costs. The method is practically free from any dimensional difficulties and is easily adaptable to individual utilities in actual practice.

25739 **Boiling water reactors.** Hermansky, B. *Jad. Energ.*; **22**: No. 2, 68-75(Feb 1976). (In Czech).

A survey is presented of the development of boiling water reactors (BWR) and of their basic concept. BWR applications in nuclear power plants are discussed. The parameters of the main componets, fuel elements and containment of BWR's are analyzed. The efforts aimed at standardizing BWR projects are illustrated by examples of GE Standard, KWU Standard and Asea-Atom BWR 75 reactors.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 25417, 25433, 25735, 25738, 25797, 25829, 25831, 25841, 25865, 25870, 25874, 25877, 25883, 25884, 25885, 25887, 25888

25740 (BNL-NUREG—50512) **Evaluation of the eddy-current method of inspecting steam generator tubing.** Flora, J.H.; Brown, S.D.; Weeks, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). 31 Mar 1976. Contract E(30-1)-16. 56p. Dep. NTIS $4.50.

The objective of this project has been to evaluate the eddy-current method of inspecting steam generator tubing by conducting a series of laboratory experiments with conventional eddy-current equipment. The experiments have involved obtaining eddy-current measurements on samples of 7/8-inch OD Inconel-600 tubing provided by the Westinghouse Nuclear Energy Systems Division. A variety of machined defects and some chemically induced flaws, such as stress corrosion cracks were fabricated in the tubing. Statistical evaluation of the data was employed to estimate the error encountered in measuring corrosion defects of various depths. It appears that the eddy-current technique can provide a reasonable measure of defect depth under certain conditions. On the other hand, the evaluation indicates that it is difficult to determine the depth of certain types of flaws with reliability and precision. Furthermore, although some defects as shallow as 10 percent of the tube wall could be detected, it was not possible to detect other types of flaws that were less than 40 percent deep even when the tube supports were not near the defects. The difficulty in detecting small volume flaws is attributed to low signal-to-noise ratio. Noise is a result of unwanted signals from test variables, such as wobble and variations in tube properties. The error in measurement of certain types of larger defects is associatedin part with test variables and also with the effects that the geometry of the defect has on the eddy-current signal patterns. The distortions in signal patterns caused by gradual wastage type defects and the poor reproducibility of signal patterns obtained from notches that represent stress corrosion cracks are described. Some developments that will rectify these detection and depth measurement problems are discussed.

25741 (CONF-760622—39) **Two- and three-dimensional reactor benchmark problems.** Vondy, D.R.; Fowler, T.B.; Cunningham, G.W.; Selby, D.B. (Oak Ridge National Lab., Tenn. (USA)). 1 Jun 1976. 19p. Dep. NTIS $3.50.

From American Nuclear Society 1976 annual meeting; Toronto, Ontario, Canada (13 Jun 1976).

Results are presented for two- and three-dimensional benchmark calculations for PWR and HTGR problems.

25742 (INIS-mf—2074) **Principle simulator for a PWR nuclear power station.** Wahlstroem, B. (Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland)). May 1975. 12p. (In Swedish). INIS.

From Scandinavian Simulation Association annual meeting; Risoe, Roskilde, Denmark (12 May 1975).

A report is given on a simulator developed for the training of operational and planning staff for the Lovisa nuclear power station in Finland. All main components of the power station are illustrated and trainees can operate the simulator in the power range 3-100 %. The model was originally developed for planning the control system of Lovisa I, for which reason the simulator project could be carried out on a relatively limited budget.

25743 (INIS-mf—3025, pp 8p, Paper NS(75)3.3) **Periodic inspection of Lovlisa I.** Poikonen, L. 1975. (In Swedish).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25744 (KURRI-TR—123, pp 40-45) **On-site irradiated fuel inspection in PWR plant.** Morioka, N. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

During the second annual inspection of Mihama Unit No.1 from March 1973, irradiated fuels were inspected on site by visual and sipping equipments. Visual inspection was performed with binocular, underwater TV and periscope. For the sipping inspection, combined wet/dry method was adopted because of its reliability and sensitivity which is very similar to NOK's method in Switzerland. The equipment consists of fuel chamber, gas circulating system and measuring system. Fuel is immersed in water in the fuel chamber. Nitrogen gas is circulated through the fuel chamber and gas sampler in order to have fission gas (Xenon-133) entrained in Nitrogen. Samples gas was analyzed by single and multichannel analyzers which were set up to integrate the counts for energy range from 50 keV to 100 keV. Multi-channel analyzer was used to display energy spectrum between 0 keV and 975 keV. About 5 weeks after shutdown, the measurements gave adequate sensitivity. The basis for determining "leaker" is the increase in count rate well beyond the background.

25745 (SVF—16) **Enrichment of water soluble substances at heat transfer surfaces in steam boilers and steam generators: a literature survey.** Kelen, T. (Stiftelsen foer Vaermeteknisk Forskning, Studsvik (Sweden)). Mar 1975. 52p. (In Swedish). (AE-MK—686). INIS.

A literature survey has been made to determine the possible need for investigations into enrichment at heat transport surfaces. The survey shows that enrichment in furnace tubes of carbon steel has led both to hydrogen embrittlement as a result of a reduction of pH and to local tube wall thinning and alkaline stress corrosion following an increase of pH. Damage caused by enrichment has occurred also in the steam generators of PWR's. Information concerning measured enrichment, observed hide-out, occurrence of normally easily soluble deposits as well as of corrosion damage requiring high concentrations lead to the conclusion that enrichment factors of the order of 10 000 are to be expected in some instances. The relationship between operational conditions and enrichment in specific cases is, however, poorly documented. The tendency to hide-out varies for different substances. This is however not evidently equivalent to variation of the corresponding enrichment factor in the solution. Enrichment at heat transfer surfaces can arise as the result of one or several of the following effects: - formation of porous deposits - poor circulation - high densities of heat flow rate - departure from nucleate boiling leading to dry-out - steam blanketing. The conclusion reached from the literature survey is that knowledge of the degree of enrichment produced under specific operational conditions is extremely inadequate.

25746 **Koeberg-Escom's planned and first nuclear power station.** Veck, A. (Electricity Supply Commission, Johannesburg (South Africa)). *Civ. Eng. Contract.*; **10**: No. 4, 19-22(Nov 1975).

Some of the background is given of Escom's planned nuclear power station, Koeberg, at Duynefontein in the Western Cape. The implications for the civil engineering industry are discussed.

25747 **Strategies for plutonium recycle in a system of pressurized water reactors.** Leaver, D.E.W. Stanford, CA; Stanford Univ. (1976). 229p. University Microfilms Order No. 76-18,781.

Thesis (Ph. D.).

A methodology is developed to allow a utility fuel manager to determine economic strategies for recycling plutonium in a system of light water reactors. One possible plutonium recycle strategy would be self-generated recycle, in which plutonium discharged from a reactor is recycled back to that same reactor as soon as possible. Another possible strategy is to recycle all the plutonium discharged from several reactors into one reactor. Such a strategy might be advantageous if the reactor receiving the plutonium were of a type that utilized plutonium more effectively than other reactors in the system. There are several considerations which affect the economics of recycling a batch of plutonium to one reactor or cycle vs. another, or which would favor a special recycling strategy. Among these are cycle energy, length of time that plutonium is stored prior to recycle, and isotopes of the plutonium. The methodology developed is used to quantitatively illustrate the effect on recycle strategy of these parameters. The problem of choosing the plutonium recycle strategy which results in the minimum fuel cost is formulated as a mathematical programming problem. The objective function for this problem is the total discounted fuel cost for the reactor system over a specified planning period. The savings of an optimal recycle strategy over self-generated recycle would be typically one million dollars per year for a utility with several large PWRs.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 25412, 25741, 25828, 25844

25748 (GA-A—13140) **Results of the General Atomic deposition loop program.** Hanson, D.L. (General Atomic Co., San Diego, Calif. (USA)). 1 Apr 1976. Contract AT(04-3)-167. 176p. Dep. NTIS $7.50.

The transport behavior of fission products in flowing helium streams has been studied to determine their deposition and re-entrainment characteristics. Such information is required for the design and safety analysis of high-temperature gas-cooled reactors (HTGRs). A small high-pressure, high-temperature loop was constructed for deposition studies at near-HTGR conditions. Five loop experiments were performed to determine the plateout distribution of iodine, strontium, and cesium. In general, the plateout activity showed an exponential decrease with distance from the source with enhanced plateout at flow disturber locations (contractions, bends, etc.) and especially in a chill section where the surface was cooled. Blowdown tests were performed on selected loop specimens to determine the amount of re-entrainment caused by abnormally high wall shear stresses. The liftoff fraction (fractional amount removed) was shown to vary approximately linearly with the shear ratio (defined as the ratio of the steady state wall shear stress under blowdown conditions to that under normal operating conditions). Blowdown results are also reported for pipe sections taken from the GAIL-IV in-pile loop. Attempts were made to correlate these plateout data with the PAD code (Plateout Activity Distribution) which was developed for prediction of plateout distribution in an HTGR primary circuit. Because of inadequate modeling of the effects of the chill section, the agreement was generally poor. Consequently, to test further the PAD code, a review of the available plateout literature was made. Plateout distributions in the Peach Bottom and Dragon HTGRs and the Battelle Memorial Institute out-of-pile loop were successfully modeled.

25749 (KURRI-TR—123, pp 33-36) **Failed fuel detection gas cooled reactor.** Kuromi, N. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

The burst cartridge detection equipment at the Tokai Nuclear Power Station is described as one of the example of the FFD in the gas cooled reactors. The detection and location of failed fuel elements makes use of the wire precipitator technique in which gaseous fission products are collected on a charged wire and their daughter activities are measured. There are three types of fuel burst, namely slow burst, rapid burst and fast burst. In order to detect slow burst and rapid burst, a sample gas taken from each of 2052 fuel channels in turn is drawn through selector valves to a precipitator in either single channel or combination of six channels. The single channel scan is most sensitive and suitable for slow burst detection. The cycle time is 8 hr., 12 min. and 48 sec. The group scan, less sensitive but quicker that of single channel, is adequate for rapid burst detection. The cycle time is 20 min. and 32 sec.. In addition to this, there is a sampling system of hot and cold ducts which monitors bulk coolant gas activities continuously to detect fast burst. The sensitivity of the system obtained by an experiment during the commissioning tests depends on fuel element surface contamination, gas activities, precipitator wire contamination and cosmic ray. Seventeen burst fuel elements have been detected by the system during seven years operation since 1966. A graph of signal change for one of them is given.

25750 (ORNL—5115) **Irradiation performance of HTGR fuel rods in HFIR experiments HRB-4 and -5.** Homan, F.J.; Long, E.L. Jr.; Hamner, R.L.; Montgomery, B.H.; Valentine, K.H.; Kania, M.J. (Oak Ridge National Lab., Tenn. (USA)). Jun 1976. Contract W-7405-eng-26. 70p. Dep. NTIS $5.00.

Experiments HRB-4 and -5 were the first tests of weak-acid-resin-derived fissile fuel. This fuel was later selected as the reference recycle fissile kernel. The WAR-derived kernels did not exhibit thermal migration during irradiation, but there was some concentration of rare-earth fission products at the inner surface of the SiC coating. These experiments were also a test of fuel rods carbonized in graphite tubes, to simulate in-block carbonization. The results of these tests showed significant problems associated with in-block carbonization, notably a mechanical interaction between particles and matrix material. A significant development program was launched to solve these problems. HRB-4 and -5 also included three specimens prepared by an extrusion fabrication route. These specimens generally performed well, although some tiny cracks in the SiC layer, apparently caused by the fabrication process but accentuated by the irradiation, were noted.

25751 **Design of a multi-purpose high temperature gas-cooled reactor system. Design of a 50MW multi-purpose high temperature gas-cooled experimental reactor.** Tsunoda, R.; Nakano, H.; Yamada, M. (Fuii Electric Co. Ltd., Tokyo (Japan)). *FAPIG (Tokyo)*; No. 72, 212-224(Feb 1974). (In Japanese).

The construction of an experimental multi-purpose high temperature gas-cooled reactor aims at the proving test of the multi-purpose utilization of nuclear heat, the irradiation test to develop heat-resistant fuel and the technological confirmation leading to a practical reactor. The preliminary design of the multi-purpose HTGR system and its safety design are explained. The system comprises a HTGR of 50 MWth, with He outlet temperature 1,000°C and inlet temperature 400°C; the reactor is connected with two loops. (Mori, K.).

25752 **Operational testing highlights of Fort St. Vrain. Vol. I.** Cadwell, J.J.; McEachern, D.W.; Read, J.W.; Simon, W.A. (General Atomic Co., San Diego, Calif. (USA)); Walker, R.F. (Public Service Co. of Colorado, Denver (USA)). pp 151-163 of In Gas-cooled reactors with emphasis on advanced systems.

Proceedings of a symposium jointly organized by the IAEA and the OECD Nuclear Energy Agency and held in Juelich, 13-17 October 1975. Vienna; IAEA (1976).

From Symposium on gas-cooled reactors with emphasis on advanced systems; Juelich, F.R. Germany (13 Oct 1975).

The 330-MW(e) Fort St. Vrain reactor, built by General Atomic for the Public Service Company of Colorado, is the first commercial High-Temperature Gas-Cooled Reactor (HTGR) employing the multi-hole block-type fuel element design. Bringing the Fort St. Vrain HTGR to commercial operation is one of the major ongoing efforts at General Atomic. The Fort St. Vrain program has progressed through construction, pre-operational testing and checkout of innumerable systems, fuel loading, initial criticality, and operational testing at power levels up to 2% rated power. Thus far, all major plant systems including the PCRV, circulators, and steam generators have demonstrated their performance adequacy during the tests performed to date. Extensive tests on the reactor core at zero power and up to 2% power have demonstrated the accuracy in the design predictions of core characteristics; measured nuclear parameters such as initial criticality, control system worths, neutron flux distributions, and temperature coefficients agreed extremely well with calculated values. Gaseous fission product release measurements to date confirmed the extensive analytical estimates. Significant unforeseen schedule delays have centered around the control rod drives, circulator service water systems, and problems arising from the introduction of large quantities of water into the primary system as well as from meeting all licensing requirements for electrical cable separation and seismic restraint systems for steam lines. To date, all tests necessary before the rise-to-full-power have been completed, and the rise-to-power programme is expected to be resumed again in the fall of 1975. The schedule delays which have arisen from mechanical, electrical, or operational problems had to be expected from the startup of a first-of-a-kind plant, but none of the problems has indicated any deficiencies with the unique advantages of the HTGR concept.

25753 The nuclear power station at Saint-Laurent-des-Eaux, France. Staalebrant, R. *ERA (Foeren. Elektr. Ration. Anvaendning)*; **49**: No. 4, 75(1976). (In Swedish).

The station has two units of 500 MW each, to be increased within a few years by two more each of 1000 MW. The existing reactors are carbon dioxide cooled and graphite moderated, using natural uranium as fuel, which is produced domestically in adequate quantities. The reactors are enclosed in 8 cm steel + 4.6 m reinforced concrete. The fuel is encapsulated in a magnesium-zirconium alloy. The fuel can be replaced during operation, 2-3 rods being changed each day from the total of 2900, and the burnup is approx. 6500 MW-days/ton. Condensers are cooled with water from the Loire, raised by 8°C in the process. Neighbouring hothouses are warmed with this water. Electricity is generated at 20 kV and transformed to 380 kV for transmission. The cost is ca. 6 centimes per kWh compared with double that value from oil. One reactor has been shut down for a year because of fusion of the fuel capsules, and repair has been hindered by high ambient radioactivity.

25754 Method for systematic interpretation of dynamic measurements in a high temperature gas-cooled reactor. Chang, S.I. Knoxville, TN; Univ. of Tennessee (1976). 234p. University Microfilms Order No. 76-17,720.

Thesis (Ph. D.).

The development and application of a technique for practical parameter identification of systems whose dynamics are described by up to 110 first order, linear differential and algebraic equations is presented. A partitioned matrix technique was developed for this purpose. To demonstrate the efficiency of the proposed technique which was used in the parameter identification algorithm in this study, three system models were analyzed: (a) Oconee I nuclear system described by twenty-nine differential equations; (b) Fort St. Vrain steam generator, described by thirteen differential and seven algebraic equations, (c) Fort St. Vrain nuclear steam supply system, described by fifty-eight differential and twenty-three algebraic equations. Computer programs were written in FORTRAN IV to make the necessary calculations; the programs were executed on the IBM 360 Model 65 computer. The accuracy and computing time of the technique were studied. Also, the use of the Fisher information matrix for answering the question of parameter identifiability was studied. The information matrix which was generated could be used to evaluate the goodness of the parameters estimated.

25755 Latest direct cycle concept aims for high efficiency. Krase, J.M.; Neill, J.M. (General Atomic Co., San Diego, CA). *Energy Int.*; **13**: No. 3, 31-33(Mar 1976).

Substantial changes were made to improve the basic concept of the direct cycle, gas-turbine HTGR, Addition of an ammonia bottoming cycle to take up waste heat from the gas turbine could boost efficiency of the system to 50 percent in the role of electricity generation.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

25756 (PNC-N—341-75-10) **Heavy-water critical experiment for FUGEN, (3). Control rod effects.** Matsumoto, M.; Haga, T.; Ueda, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Jun 1975. 27p. INIS.

From ANS 21st annual meeting; New Orleans, USA (1975).

The control rod experiment has been done in Deuterium Critical Assembly (DCA) by using annular absorbers which simulate control rods of FUGEN reactor, a prototype heavy-water moderated, boiling-light-water cooled, and pressure tube type reactor. The DCA cores for this experiment use 1.2% enriched UO_2 fuel, and consist of 28-pin fuel clusters arranged in a square array of 22.5 cm lattice pitch. The experiment has been carried out with various control rod geometries, and also with varying coolant void fraction. Experimental results have been analyzed by the "Absorption Area Method", which was employed in the calculation of the FUGEN control rod design. The calculated reactivity worth agreed with the experiment within +-10%. The calculation tended to somewhat over-estimate the reactivity worth for the non-voided core, and under-estimate for the voided core. This tendency was greatly improved by considering the anisotropy effect of migration area M^2 of the cluster lattice.

25757 Development of the neutron detector for prototype ATR 'Fugen'. Aoki, H. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)); Shiroyama, S. *Doryokuro Giho;* No. 12, 38-43(Nov 1974). (In Japanese).

In the prototype ATR (advanced thermal reactor) "Fugen", three types of neutron detector, i.e. start-up monitor, power-up monitor, and local power monitor, are used. Of these, the LPM used in power output region is especially important; the absorption of neutrons by neutron detectors must be as small as possible in the ATR, since the excess neutrons are utilized for fuel reproduction. The detecting element itself is a small ionization chamber, using 235u. The local power monitor for the ATR has been constructed for trial, and subjected to irradiation in JMTR (Japan Material Testing Reactor). It was found that the detector showed good linearity in a high neutron field. Zircaloy is sufficient for a structural material, absorbing little neutrons. (Mori, K.).

25758 Stress analysis of a control valve (inner diameter/rated pressure = 500/100) of the A-1 nuclear power plant primary coolant circuit. Seps, V.; Opocensky, I. (Sigma, Prague (Czechoslovakia). Vyzkumny Ustav Cerpacich Zarizeni, Potrubi a Armatur). *Energetika;* **25**: No. 10, 460-464(1975). (In Czech).

The course and the results of measurements are described in stress analysis of a valve controlling the inlet pressure of the primary coolant circuit of the A-1 nuclear power plant. The analysis comprised the measurements of both static and dynamic strength, including vibrations of the valve body and the appropriate piping as well as coolant pressure pulsations. Also determined were the course of excitation forces, basic torsional and bending frequencies, and the resonance valve frequency under simulated main operating loads.

25759 Calandria tube cladding. Martin, D.J.V. (to UKAEA London Office). Canadian Patent 974668. 16 Sep 1975. 4p.

Available from Commissioner of Patents, Ottawa.

A calandria vessel for a pressure tube nuclear reactor is constructed of aluminium-magnesium alloy and the calandria tubes are clad with zirconium alloy to reinforce them against damage by missiles propagated by a burst pressure tube.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 25427, 25830, 25853, 25866, 25867, 25868, 25872, 25873, 25875, 25876, 26126

25760 (BNL-NUREG—21260) **Modifications to the HELAP code.** Ludewig, H. (Brookhaven National Lab., Upton, N.Y. (USA)). Feb 1976. Contract E(30-1)-16. 23p. Dep. NTIS $3.50.

The improvements made to the steam generator model originally developed for the HELAP code and improvements made to the HELAP code itself are described. In the first case, the numerical algorithm which solves the controlling equations of the steam generator was re-cast into a purely implicit scheme. This change was motivated by excessive running time and numerical instabilities brought about by rapidly varying heat transfer coeffi-

cients when the fluid changes phase. The second of the above mentioned changes was the inclusion of closed form expressions to describe the thermodynamic properties on the primary (helium) side rather than the table look up technique. These expressions treat the helium as a real gas. This step has two advantages: first, the limits customarily imposed by a table are eliminated, and second, the determination of new pressures, temperatures and enthalpies at each time step are accomplished more rapidly. Finally, an outline is given of the extra input required to execute a problem using HELAP.

25761 (CONF-760503—3) **Control of tritium in LMFBR sodium by cold trapping.** McPheeters, C.C.; Raue, D. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 7p. Dep. NTIS $3.50.

From International conference on liquified metal technology in energy production; Champion, Pennsylvania, United States of America (USA) (3 May 1976).

Control of tritium in the sodium coolant of LMFBRs is important for achieving as low as practicable release of radioactivity. Cold-trapping has been shown to be an effective method for controlling hydrogen in sodium and should be effective for controlling tritium as well. Two mechanisms for removal of tritium from sodium have been studied: (1) coprecipitation of hydrogen and tritium from solution in sodium in a cold trap and (2) isotopic exchange of tritium in sodium with hydrogen in solid NaH in a cold trap. Mathematical models have been developed to describe the two mechanisms and experimental runs have been made to determine their relative effectiveness. These experiments, together with the models, have indicated that the coprecipitation mechanism is, as expected, much more effective in removing tritium from sodium than the isotopic exchange mechanism. The model was used to calculate tritium levels in the EBR-II primary system, and agreement with measured levels was achieved within a factor of three. The isotopic exchange mechanism by itself cannot be expected to adequately control tritium in LMFBRs. Hydrogen sources such as corrosion in the steam generators will be important factors in controlling the tritium level.

25762 (GA-A—13868) **Gas-Cooled Fast Breeder Reactor. Quarterly progress report, February 1, 1976—April 30, 1976.** (General Atomic Co., San Diego, Calif. (USA)). 31 May 1976. Contract E(04-3)-167. 218p. Dep. NTIS $7.75.

The tasks of the gas-cooled fast breeder reactor (GCFR) program include development of GCFR fuel, blanket, and control elements; development of the pressure equalization system for GCFR fuel; out-of-pile loop facility test program planning; fuels and materials development; fuel, blanket, and control rod analyses and development; nuclear analysis and reactor physics for GCFR core design; shielding requirements for the GCFR; reactor engineering to assess the thermal, hydraulic, and structural performance of the core and the core support structure; plant systems control; development of reactor components, including reactor vessel, control and locking mechanisms, fuel handling equipment, core support structure, shielding assemblies, main helium circulator, steam generator, and auxiliary circulator; development of a helium circulator test facility; and reactor safety, including an in-pile safety evaluation program.

25763 (GEAP—13771-18) **Critical experiments and analysis. Eighteenth quarterly report, January—March 1976.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Apr 1976. Contract E(04-3)-893. 104p. AT.

Current activities and technical progress for the period January through March 1976 are reported for three subtasks. Subtask A covers the technical direction for critical experiments and analysis as applicable to LMFBR commercial plants and the Clinch River Breeder Reactor Plant Benchmark Critical Experiments in ZPPR Assembly 4 and the CRBRP EMC. Subtask B is directed toward the development of LMFBR plant calculational methods that also can be used at the sites of the Clinch River Breeder Reactor to determine the reactor power distribution, reactivity and fuel status, and for consideration of alternative fuel and control management schemes. Subtask C is directed toward the development of nuclear design extrapolation techniques which will allow the extrapolation of nuclear design data from one LMFBR design to another, e.g., extrapolation of critical experiment data to LMFBR.

25764 (GEAP—14029-5) **Steam generator materials engineering fifth quarterly report, July—September 1975. 189 No. SG028 FY76.** Challenger, K.D. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Oct 1975. Contract E(04-3)-893. 68p. AT.

Progress is reported in studies designed to characterize materials, mainly 2-1/4Cr—1Mo and stainless steels, to assure that satisfactory materials compatibility is achieved with expected LMFBR steam generator environments. Data are presented on decarburization in sodium, steam corrosion, creep, and fracture properties.

25765 (GEAP—14029-7) **Steam generator materials engineering. Seventh quarterly report, January—March 1976.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Apr 1976. Contract E(04-3)-893. vp. AT.

Progress is reported on studies to characterize materials, mainly $2^1/_4$Cr-1Mo and stainless steels, to assure that satisfactory materials compatibility is achieved with expected LMFBR steam generator environments. The studies cover decarburization kinetics, mechanical properties of stainless steel in sodium, intermediate heat transport system, particulate deposition, and fracture toughness of steam generator materials.

25766 (GEAP—14045-4) **Reliability program for shutdown heat removal. Fourth quarterly report, September 1975—February 1976.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Mar 1976. Contract E(04-3)-893. vp. AT.

LMFBR shutdown heat removal systems reliability activities are reported for the period beginning in September 1975, and ending in February 1976. Activities reported include completion of an update of the preliminary reliability prediction for Clinch River Breeder Reactor Plant shutdown heat removal systems, and completion of the critical items list for LMFBR shutdown heat removal systems. In addition, the primary pipe integrity status report for CRBRP was prepared during this report period.

25767 (GEAP—14100) **Nondestructive examination requirements for the CRBRP steam generator system.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Mar 1976. Contract E(04-3)-893. 26p. AT.

The needs for nondestructive testing of the Clinch River Breeder Reactor Project (CRBRP) Steam Generator System (SGS)are described. The existing state of the art in nondestructive testing is examined with regard to the needs of the CRBRP Steam Generator System (SGS). The needs for new development are defined in terms of system requirements to augment the state of the art. Plans are described for applying existing methods to the SGS components, and a schedule is presented showing milestones for completion of needed development for meeting CRBRP scheduling goals.

25768 (HEDL-TME—76-16) **Fabrication, irradiation and postirradiation examination of mixed oxide fuel pins PNL 5-5, -22, -31, and -35.** Baird, G.R.; Chastain, S.A.; Hendersen, R.G. (comps.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1976. Contract E(45-1)-2170. 216p. AT.

PNL-5-5, -22, -31 and -35 were four unencapsulated fuel pins of a 37-pin subassembly (PNL-5) which was irradiated in the EBR-II. This document presents a compilation of design, specifications and fabrication data, irradiation information and the results of the postirradiation examinations. Three different smear densities (85, 88 and 89 percent) were included in these fuel pins and both solid and annular fuel pellets were used. The 304 SS cladding had an outside diameter of 0.250 in., and a wall thickness of 0.016 in. Each pin was wrapped with a 304 SS spacer wire 0.62 in. diameter with a 12 in. pitch. Nominal pin length was 60-7/8 in. The subject pins were removed from the subassembly for both nondestructive and destructive examination after an exposure of 222 equivalent full power days (at 50 MW). The pins operated at peak linear powers ranging from 12.1 to 12.5 kW/ft and the peak cladding temperature attained was 939°F. Examinations of the pins revealed no significant damage or deterioration.

25769 (KURRI-TR—123, pp 58-63) **Failed fuel detection and location of LMFBR.** Mimoto, Y.; Hukuda, T.; Nakamoto, K. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

A summary report is presented on Failed Fuel Detection and Location Methods of liquid metal cooled fast breeder reactors. Related research and development conducted by PNC are described.

25770 (ORNL—5162) **Nondestructive testing development program. Quarterly progress report for period ending March 31, 1976.** Hill, M.R. (comp.). (Oak Ridge National Lab., Tenn. (USA)). May 1976. Contract W-7405-eng-26. 65p. AT.

Nondestructive testing (NDT) research for LMFBR components is reported. Included are NDT techniques and equipment for inspection and monitoring of steam generator tubes and welded joints, sodium rupture discs, and DNB water tubes. NDT methods discussed employ ultrasonics, radiography, and eddy currents. (DG)

25771 (PNC-N—241-75-07) **Thermal and stress analyses with ANSYS program. ANSYS report 6-18.** Kanoo, I.; Kawaguchi, O.; Asakura, J. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Mar 1975. 418p. (In Japanese). INIS.

Some analyses of the heat conduction and elastic/inelastic stresses, carried out in Power Reactor and Nuclear Fuel Development Corporation (PNC) in fiscal 1973 using ANSYS (Engineering Analysis System) program, are summarized. In chapter I, the present state of structural analysis programs available for a FBR (fast breeder reactor) in PNC is explained. Chapter II is a brief description of the ANSYS current status. In chapter III 8 examples are presented of the steady-state and transient thermal analyses for fast-reactor plant components, and in chapter IV are 5 examples of the inelastic structural analysis.

25772 (WARD-TP—3045-1) **LMFBR shutdown system reliability test rig program progress report for period ending February 1976.** (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). May 1976. Contract E(11-1)-3045. 27p. AT.

Technical progress in the LMFBR shutdown system reliability program is reported. The program covers component tests, subsystems tests, and systems tests for CRBRP and LMFBR shutdown systems.

25773 **Leaktight sealing of heat exchanger pipes for leak detection.** (to Neratoom N.V.). Netherlands Patent 7,409,872/A/. 22 Jul 1974. 5p. (In Dutch).

1 fig.

Leak detection in the pipes of a heat exchanger in a steam generator attached to a sodium-cooled reactor is a highly complicated and time-consuming matter. A sealing system with easy access to the pipe ends protruding into the collector is presented. A rubber bag filled with warm liquid paraffin is brought into the collector after removal of water and sodium. The bag is attached to each pipe end in turn and the paraffin solidifies and then closes the pipe which is connected to the leak detector at its other end. The closure is vacuum-tight so that detection with gas is possible.

25774 **Liquid cooled nuclear reactor.** (to UKAEA). French Patent 2,241,850/A/. 23 Aug 1974. 7p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The reactor comprises a core immersed in a coolant mass contained in a vessel an a tray for receiving fuel scraps falling from said core; said tray comprises an assembly of collector open-topped containers provided with central support stems and a structure for supporting said containers. The latter is spaced apart and distributed in layers, the container-pattern of each layer being offset with respect to the patterns of the other layers so that the containers in any layer slightly overlap those in the lower layers, the arrangement being such that the whole constitutes an uninterrupted area for receiving falling circulating upwardly through convection. This can be applied to liquid cooled nuclear-reactors, and in particular to fast reactors.

25775 (EURFNR—1286) **Fast Breeder Project. Second quarterly report, April 1—June 30, 1975.** (Kernforschungszentrum Karlsruhe (Germany, F.R.)). 1975. Translation of KFK—1275/2. (EUR—5205d). 238p. Dep. NTIS $8.00.

Work performed under United States—Euratom Fast Reactor Exchange Program.

Work carried out under the Fast Breeder Project by the Gesellschaft fur Kernforschung mbH Karlsruhe or on its behalf during the second quarter of 1975 is described. The main results of the individual projects included fuel pin development, material studies, physics corrosion tests, safety instrumentation, and sodium technology.

25776 (EURFNR—1273) **Ultrasonic sweep arm for use in sodium-cooled reactors.** Rohrbacher, H.A.; Bartholomay, R. (Kernforschungszentrum Karlsruhe (Germany, F.R.)). May 1975. Translation of KFK—2117. 32p. Dep. NTIS $4.00.

Work performed under United States—Euratom Fast Reactor Exchange Program.

The experience in the use of a new type of monitoring and testing device to be applied in conjunction with components under sodium is described. In the method outlined, ultrasonic pulses are used which are emitted into the sodium plenum of fast breeder reactors by newly developed high temperature transducers. The basic work was conducted under out-of-pile conditions in a sodium tank of the sodium tank facility of the Karlsruhe Institute for Reactor Development. The sensor development, which preceded this phase, resulted in the use of soldered lithium niobate crystals whose operating characteristics were improved by the preliminary treatment outlined in the report. Special materials and techniques suitable for sensor fabrication are proposed. An alternative to soldering is suggested for contacting the crystals with their diaphragms, i.e., a contact pressure concept for the range of application up to 2 MHz.

25777 **Apparatus for the removal of after heat in a sodium-cooled fast reactor.** Cachera, P.C. (to Electricite de France). US Patent 3,968,653. 13 Jul 1976. Priority date 2 Oct 1973, France. 6p.

In a fast reactor in which each cooling loop comprises the primary sodium circuit which exchanges heat with the sodium of a secondary circuit by means of an intermediate heat exchanger, each cooling loop comprises in parallel with the secondary sodium circuit an auxiliary secondary circuit in which a chemically inert gas extracts heat from the primary sodium, said secondary auxiliary circuit being equipped with at least one gas turbine which is supplied with the inert gas and operates in a closed energy-producing gas cycle.

REGULATION AND LICENSING

REFER ALSO TO CITATION(S) 25403, 25404

25778 (DOCKET-50293—619) **Pilgrim Nuclear Power Station, Unit 1. Annual operating report, 1975.** (Boston Edison Co., Mass. (USA)). 27 Feb 1976. 40p. Dep. NTIS $4.00.

Net electrical power generated was 2,587,248 MWH(e) with the reactor on line 6,242.4 hr. Information is presented concerning operations, power generation, shutdowns, corrective maintenance, chemistry and radiochemistry, occupational radiation exposure, release of radioactive materials, and reportable occurrences. (FS)

25779 (FIND—50548) **FIND: Fort Calhoun Station, Unit 2.** Williams, W.H. (ed.). (Nuclear Regulatory Commission, Washington, D.C. (USA)). Jul 1976. 13p. NTIS.

This index is presented for the microfiche material of Docket 50548 which concerns the application of Omaha Public Power District to build and operate Fort Calhoun Station, Unit 2. The information includes both application and review material dated from September 1975 through March 1976. There are five amendments to the PSAR and one supplement to the ER which have been incorporated by reference into the respective reports. Docket RESAR-3 is used as a reference for portions of the PSAR.

25780 (INIS-mf—3025, pp 9p, Paper NS(75)2.4) **The organisation and work of the Swedish authorities.** Eckered, T. 1975. (In Swedish).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25781 (INIS-mf—3025, pp 7p, Paper NS(75)2.2) **The organisation and working methods of the Finnish authorities.** Eurola, T. 1975. (In Swedish).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25782 (INIS-mf—3025, pp 3p, Paper NS(75)3.2) **Planning and carrying through the U.S. Nuclear Regulatory Commission's reactor inspection programme.** Hagen, H. 1975. (In Danish).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25783 (INIS-mf—3025, pp 8p, Paper NS(75)2.1) **Quality assurance principles in relation to future Danish atomic power stations.** Moeller-Madsen, M. 1975. (In Danish).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25784 (INIS-mf—3025, pp 8p, Paper NS(75)2.3) **The work of the Norwegian authorities.** Moelsaeter, M. 1975. (In Norwegian).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25785 (SAAS—193) **Specifying with respect to contents and timing of the technical documentation necessary for the consent to initial operation of nuclear power plants.** Albrecht, L. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Feb 1976. 12p. (In German). INIS.

In the 'Regulation Concerning the Granting of Radiation Protection Licenses for Nuclear Plants' of 4 December 1969 the necessary documents to be submitted for the consent to initial operation are mentioned globally only. The contents of this documentation and the time of submission the corresponding documents to the National Board of Nuclear Safety and Radiation Protection are specified.

ECONOMICS

25786 (AES—14) **Energy analysis and projecting of power plants.** Jirlow, K. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1975. 44p. (In Swedish). INIS.

Energy analysis aims at a better explanation of energy flow and energy exchange at different production processes. The energy budget is analysed for separate nuclear power plants and for expanding systems of power plants. A mathematical model is developed for linear and exponential expanding of nuclear power. The profitableness for nuclear power plants in Sweden is considered to be good.

25787 (BNL—50551) **Future of nuclear power in the Northeast.** Sailor, V.L.; Shore, F.J. (Brookhaven National Lab., Upton, N.Y. (USA)). 30 Mar 1976. Contract E(30-1)-16. 229p. Dep. NTIS $8.00.

As of July 1975, there were 15 operable nuclear power plants in the Northeast, representing approximately 11 percent of the regional electric generating capability. Construction plans for the next two decades show a strong preference for nuclear units, there being 18 new units under construction and 33 additional units announced. Three projections (scenarios) covering the period from 1976 to 2000 are presented. The Base Case Nuclear Scenario assumes that the construction schedules as of August 31, 1975 are implemented. A Nuclear Moratorium Scenario assumes that no new plants are undertaken after January 1, 1977. Finally, a Maximum Nuclear Growth Scenario postulates a concerted effort to add additional nuclear capacity beginning in 1982, but constrained by the ability of industry to expand the capabilities needed to supply the components and fuel. Appreciable differences in the three scenarios do not appear until about 1985, a consequence of the long lead time in making plans and completing construction. The cumulative incremental costs of the Nuclear Moratorium Scenario postulated in this study exceed $160 billion by the year 2000. Despite the present favorable economics and performance of the nuclear units, and despite the strong preference of the planners for nuclear capacity to meet future demands, there are many factors which cast doubt on whether these plans will be executed. Cost escalation, combined with difficulties in raising capital funds, have forced many units to be deferred or canceled.

25788 (ORNL-MIT—138) **Total energy analysis of nuclear and fossil fueled power plants.** Franklin, W.D.; Mutsakis, M.; Ort, R.G. (Massachusetts Inst. of Tech., Oak Ridge, Tenn. (USA). School of Chemical Engineering Practice). 23 Nov 1971. 61p. Dep. NTIS $4.50.

The overall thermal efficiencies of electrical power generation were determined for Liquid Metal Fast Breeder, High Temperature Gas Cooled, Boiling Water, and Pressurized Water Reactors and for coal-, oil-, and gas-fired systems. All important energy consuming steps from mining through processing, transporting, and reprocessing the fuels were included in the energy balance along with electrical transmission and thermal losses and energy expenditures for pollution abatement. The results of these studies show that the overall fuel cycle efficiency of the light water nuclear fueled reactors is less than the efficiency of modern fossil fuel cycles. However, the nuclear fuel cycle based on the fast breeder reactors should produce power more efficiently than the most modern supercritical fossil fuel cycles. The high temperature gas cooled reactor has a cycle efficiency comparable to the supercritical coal fuel cycle.

25789 **Construction and operating costs of power stations.** Sorin, F. *Rev. Gen. Nucl.*; **1**: No. 3, 183-188(Jul 1975). (In French).

The author analyses the papers presented by H. Mandel and J. Feron at the Paris Conference on the maturity of nuclear energy. The main factors which have led during recent years to a noticeable increase in the construction costs of nuclear power stations are presented. Nevertheless, in spite of the increases which have taken place, nuclear power remains largely competitive as compared to the conventional types of energy. This is shown by a study of the operating costs of nuclear power stations. By defining the structure of the production costs of electric power in a small power station and by giving an analysis of how these costs are influenced by variations in the different economical or technical parameters, it is shown that the cost of the nuclear kWh is still very much less than that of the kWh generated in the conventional type of thermal power station.

FUEL CYCLE

REFER ALSO TO CITATION(S) 25459, 25460, 25461, 25493

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 25751, 25925

NUCLEAR REACTOR TECHNOLOGY

25790 (RISO-M—1838) **Department of Reactor Technology annual progress report, 1 January—31 December 1975.** (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1976. 61p. INIS.

The work of the Department of Reactor Technology within the following fields is described: Reactor engineering, Steel pressure vessel research, Reliability, Reactor physics, Steady-state thermohydraulics, Accident analysis, Containment analysis, Experimental heat transfer, Core dynamics and power plant simulators, Experimental activation measurements and neutron radiography at the DR 1 reactor.

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 26736, 26754

25791 (DP-MS—76-7) **Response Matrix Method Development Program at Savannah River Laboratory.** Sicilian, J.M. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1976. Contract AT(07-2)-1. 30p. (CONF-760622—35). Dep. NTIS $4.00.

From American Nuclear Society 1976 annual meeting; Toronto, Ontario, Canada (13 Jun 1976).

The Response Matrix Method Development Program at Savannah River Laboratory (SRL) has concentrated on the development of an effective system of computer codes for the analysis of Savannah River Plant (SRP) reactors. The most significant contribution of this program to date has been the verification of the accuracy of diffusion theory codes as used for routine analysis of SRP reactor operation. This paper documents the two steps carried out in achieving this verification: confirmation of the accuracy of the response matrix technique through comparison with experiment and Monte Carlo calculations; and establishment of agreement between diffusion theory and response matrix codes in situations which realistically approximate actual operating conditions.

25792 (EUR—5274) **Recommendations on the measurement of irradiation received by the structural materials of reactors.** Genthon, J.P.; Hasenclever, B.W.; Schneider, W.; Mas, P.; Wright, S.B.; Zijp, W.L. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). 1975. 30p. (In French). INIS.

Also published in German, English, Dutch.

The recommendations have been compiled by a working group Radiation Damage which has been set up by the Euratom Working Group for reactor Dosimetry. The parameters are indicated which must be defined for the characterisation of the neutron dose causing radiation-induced damage in construction materials important for reactor technique. Following an explanation of some theoretical aspects, practical guidelines for neutron metrology on irradiation of graphite and of metals are given. A thorough knowledge of the spectrum of the incident neutrons is required for a proper interpretation of the results of irradiation experiments.

25793 (IA--1312) **Nuclear data and multigroup methods in fast reactor calculations.** Gur, Y. (Israel Atomic Energy Commission, Tel Aviv; Technion-Israel Inst. of Tech., Haifa). Mar 1975. 186p. (In Hebrew). INIS.

Thesis. 71 refs.

The work deals with fast reactor multigroup calculations, and the efficient treatment of basic nuclear data, which serves as raw material for the calculations. Its purpose is twofold: to build a computer code system that handles a large, detailed library of basic neutron cross section data, (such as ENDF/B-III) and yields a compact set of multigroup cross sections for reactor calculations; to use the code system for comparative analysis of different libraries, in order to discover basic uncertainties that still exist in the measurement of neutron cross sections, and to determine their influence upon uncertainties in nuclear calculations. A program named NANICK which was written in two versions is presented. The first handles the American basic data library, ENDF/B-III, while the second handles the German basic data library, KEDAK. The mathematical algorithm is identical in both versions, and only the file management is different. This program calculates infinitely diluted multigroup cross sections and scattering matrices. It is complemented by the program NASIF that calculates shielding factors from resonance parameters. Different versions of NASIF were written to handle ENDF/B-III or KEDAK. New methods for evaluating in reactor calculations the long term behavior of the neutron flux as well as its fine structure are described and an efficient calculation of the shielding factors from resonance parameters is offered.

25794 (IFA-FR—128-1975) **A method of numerical solution of the thermalization equation as applied to the physical calculation of a nuclear reactor.** Grigorescu, A.M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 19p. (In Rumanian). INIS.

A relatively serious calculation of the energy spectrum of thermal neutrons in a reactor is presented by solving the system of energy dependent coupled equations. In this system, the Spectrox method in a heterogenous thermal lattice cell was used.

25795 (IFA-FR—146-1975) **Utilization of the perturbation method for determination of the buckling heterogenous reactors.** Gheorghe, R. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 13p. (In Romanian). INIS.

Evaluation of material buckling for heterogenous nuclear reactors is a key-problem. In this direction several methods have been elaborated: bi-group method, heterogenous method and perturbation methods. The perturbation method is presented and is applied in some parameter calculations of a new cell type for which fuel is positioned in the marginal area and the moderator is in the centre. It is based on the technique of progressive substitution. Advantages of the method: buckling comes out clearly, high level defects due to differences between O perturbated fluxes and the unperturbated flux Osub(o) can be corrected by an iterative procedure; using a modified bi-group theory, one can clearly describe effects of other parameters.

25796 (IFA-TR—60-1975) **Dynamic response of a system with internal heat sources cooled by a flowing incompressible fluid.** Georgescu, R.; Dobrescu, C. (Institutul de Fizica Atomica, Bucharest (Romania)). 1975. 15p. INIS.

The paper investigates the dynamic temperature response of an incompressible fluid which cools a duct with internal heat sources sinusoidally oscillated. The analytical results utilise the Laplace transformation technique. The experimental and calculated results are obtained by the transfer function approach. Comparison of the calculated with the experimental data indicates agreement from 6 to 24 percent for the amplitude and up to 30 degree for the phase-shift. All the calculated data are below the experimental values. The transfer function approach may be utilized for the initial calculations giving good results for flow rates above 1000 kg per hour.

25797 (ITN—101-1975) **The DACC system. Code burnup of cell for projection of the fuel elements in the power net work PWR and BWR.** Cepraga, D.; Boeriu, S.; Gheorghiu, E.; Cristian, I.; Patrulescu, I.; Cimporescu, D.; Ciuvica, P.; Velciu, E. (Institutul Pentru Tehnologii Nucleare, Pitesti-Colibasi (Romania)). 1975. 23p. (In Romanian). INIS.

The calculation system DACC-5 is a zero-dimensional reactor physics code used to calculate the criticality and burn-up of light-water reactors. The code requires as input essential extensive reactor parameters (fuel rod radius, water density, etc.). The nuclear constants (intensive parameters) are calculated with a five-group model (2 thermal and 3 fast groups). A fitting procedure is systematically employed to reduce the computation time of the code. Zero-dimensional burn-up calculations are made in an automatic way. Part one of the paper contains the code physical model and computer structure. Part two of the paper will contain tests of DACC-5 credibility for different light-water power lattices.

25798 **Determination of multiplication factors using experimental lattice parameters of cluster-type fuel lattices.** Ueda, M. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). *J. Nucl. Sci. Technol. (Tokyo)*; **12**: No. 4, 229-242(Apr 1975).

A new four-factor formula is proposed for deriving a "finite multiplication factor" k - the ratio between neutron production and absorption rates in a finite medium - from experimentally determined lattice parameters in a slightly-enriched Pu-U lattice. The "two-group multiplication factor" k sub(infinity2) - related to tau+L^2 and equal to (1+tau Bsub(C)²).(1+L^2Bsub(C)²) at criticality - is derived from k . The experimental lattice parameters are corrected to account for neutron leakage, from which the "infinite multiplication factor" ksub(infinity) is derived. Differences are found between k , k sub(infinity2) and ksub(infinity) amounting to about 1--2% in the Advanced Thermal Reactor (ATR)-type heavy-water lattice, despite the fact that all these three quantities are often indiscriminately called "infinite multiplication factor." The proposed four-factor formula for deriving k was applied to the Deuterium Critical Assembly (DCA) of 1.2%-enriched UO_2 lattices of 28-pin clusters in square arrays spaced at 22.5 cm. The values of k calculated with a lattice design code METHUSELAH II were in fairly good agreement with those determined by experiment. The calculation tended to somewhat overestimate k , particularly in lattices of highly voided coolant. A similar tendency was observed in the case of 1.5%-enriched UO_2 lattices of 22.5 cm pitch in the ATR Sumitomo-Two-Region Critical Facility.

25799 **A method of predicting interaction on control rod worth through 'disturbance parameters'.** Konishi, T.; Yamamoto, M. (Hitachi Ltd., Kawasaki, Kanagawa (Japan). Atomic Energy Research Lab.). *J. Nucl. Sci. Technol. (Tokyo)*; **12**: No. 6, 336-343(Jun 1975).

A method has been developed for predicting the interaction effect on control-rod worth and applied to a fast reactor system. The method is based on the exact perturbation theory to which several assumptions have been applied. These assumptions - numerically confirmed to be valid - all relate to separability of the effects on flux change brought by different factors of perturbation. The method permits prediction of the worth of a combination of any number of control rods solely from information obtained on single-rod worth calculations. Adoption of this method reduces from 2sup(N) to N+1 the number of calculations necessary for N rods of interest. Comparison with results obtained by the conventional direct k-difference method has revealed that the present method predicts the worth of a combination of control rods to within a few percent - 1.3% at most in seven numerical examples studied, covering both symmetric and a symmetric rod configurations and with the interaction effect ranging from about -10% to +15%.

25800 **Integral-versions of some kinetic experiments for determining large negative reactivity of reactor.** Kaneko, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). *J. Nucl. Sci. Technol. (Tokyo)*; **12**: No. 7, 402-412(Jul 1975).

Theoretical treatments, including the methods of source-multiplication, rod-drop and source-jerk, are suggested for dealing with the spatial effects observed in several kinetic experiments for determining large negative reactivity in a reactor. An analysis by means of kinetic eigenfunctions is made on the kinetic behavior of the reactor, when these methods are applied. For each kind of experiment, a new multi-point formula is established to replace the current single point expressions, in order to derive the precise reactivity value by utilizing all of the neutron counting data obtained from every part of the reactor core. In the new formulas, the raw neutron counting data are integrated with reference to space and energy and weighted with the product of the static adjoint-neutron density and the static fission spectrum. This integral procedure is effective in eliminating the effects of kinetic distortion and of the spatial harmonics included in the raw counting data. In addition, using the kinetic eigenfunctions, a new formula is also presented for determining the effective intensity of the source neutrons injected in the neutron source introduction method for absolute measurements of reactor power.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 26064, 26075, 26267, 26271

25801 (CONF-760707—2) **Effects of shield impedance, connector resistance, and coaxial inductors on ground noise interference in nuclear reactor instrumentation systems.** Burns, R.S. (Oak Ridge National Lab., Tenn. (USA)). 10 Feb 1976. 15p. Dep. NTIS $3.50.

From International symposium of elecromagnetic compatibility; Washington, District of Columbia, United States of America (USA) (13 Jul 1976).

Electrical noise interference in low-level (approximately 50 μV), wide band (approximately 15 MHz) flux monitoring systems applied to nuclear reactor control causes safety and reliability problems. Others have shown that one predominant source of noise interference is conduction of currents in instrument cable shields and building conduits. Since these currents produce noise that is similar to signals produced by nuclear detectors, such noise interference reduces the ability of a reactor instrumentation system to determine the condition of a reactor. Model equations of ground noise interference were derived for a system model consisting of a sensor, coaxial cable, and an amplifier. These equations describe the effect of ground impedance, sensor impedance, transfer impedance, and connector resistance on both low-frequency (less than 100 kHz) and high-frequency (greater than 100 kHz) ground noise interference. Other model equations were derived for a system with a coaxial balun (a flexible coaxial cable wound around a ferrite core) added between the sensor and the sensor amplifier input. Analysis of the model equations reveals the effects of ground noise currents on instrumentation systems and the conditions for minimizing ground interference.

25802 (CONF-760905—1) **Experimental stress analysis for four 24-in. ANSI standard B16.9 tees.** Hayes, J.K.; Moore, S.E. (Combustion Engineering, Inc., Chattanooga, Tenn. (USA); Oak Ridge National Lab., Tenn. (USA)). 1976. 63p. Dep. NTIS $4.50.

From International joint pressure vessels and piping and petroleum mechanical engineering conference; Mexico City, Mexico (19 Sep 1976).

The experimental stress analysis and low cycle fatigue tests of four tees tested by Combustion Engineering, Inc. (E-E) under subcontract to Union Carbide Nuclear Division are described. These tests are part of the ORNL Design Criteria for Piping and Nozzles Program which is being conducted for the development of design criteria for nuclear power plant service piping components. The test assemblies were fabricated at C-E from commercially obtained ANSI B16.9 tees and matching diameter steel pipes welded to the tees, with suitable and closures and fixtures for applying the loads.

25803 (CONF-760905—5) **Experimental stress analyses of cylinder-to-cylinder shell models and comparisons with theoretical predictions.** Gwaltney, R.C.; Corum, J.M.; Bolt, S.E.; Bryson, J.W. (Oak Ridge National Lab., Tenn. (USA)). 1976. Contract W-7405-ENG-36. 38p. Dep. NTIS $4.00.

From International joint pressure vessels and piping and petroleum mechanical engineering conference; Mexico City, Mexico (19 Sep 1976).

Four carefully machined cylinder-to-cylinder shell models were tested, and the experimentally determined stresses were compared with theoretical predictions obtained from a thin-shell finite-element analysis. The models were idealized structures consisting of two circular cylindrical shells intersecting at right angles. The first model tested had a nozzle-to-cylinder diameter ratio of 0.5 and a diameter-to-thickness of 100 for both nozzle and cylinder. The second model had a nozzle-to-cylinder diameter ratio of 1.0 with a diameter-to-thickness ratio of 100. The third and fourth models had a nozzle-to-cylinder ratio of 0.129. For these models the diameter-to-thickness ratio was 50 for the cylinders and 7.68 for the nozzle of model 3, while it was 20.2 for the nozzle of model 4. All models were strain gaged and subjected to 13 separate loading cases. Comparisons of measured and predicted stress distributions are presented for three of these loadings - internal pressure, and in-plane and out-of-plane moments applied to the nozzle. The analytical predictions were obtained using a finite-element program that used flat-plate elements and which considered five degrees of freedom per node in the final assembled equations. The agreement between these particular finite-element predictions and the experimental results is shown to be reasonably good for the four models.

25804 (INIS-mf—3025, pp 5p, Paper NS(75)1.1) **Quality assurance in the manufacture of pressure vessels.** Johansson, J.E. 1975. (In Swedish).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25805 (INIS-mf—3025, pp 3p, Paper NS(75)3.4) **Experience from basic investigations and periodic inspections at Swedish atomic power stations.** Junghem, A. 1975. (In Swedish).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25806 (INIS-mf—3025, pp 16p, Paper NS(75)1.2) **Quality assurance of mechanical equipment.** Langser, B. 1975. (In Swedish).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25807 (INIS-mf—3025, pp 6p, Paper NS(75)4.1) **Swedish operational experience shows that proven, uniform, quality components are the key to progress.** Reisch, F. 1975. (In Swedish).

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25808 (ORNL/NUREG/TM—18) **Progress report for the design criteria for piping and nozzles program for the two quarterly periods July 1—September 30 and October 1—December 31, 1975.** Moore, S.E.; Bryson, J.W. (Oak Ridge National Lab., Tenn. (USA)). Jun 1976. Contract W-7405-eng-26. 46p. Dep. NTIS $4.50.

The activities and accomplishments of the Design Criteria for Piping and Nozzles Program during the last six months are reviewed. Precis are given of the reports published by program personnel about stresses at nozzles in spherical shells, about stresses at openings in cylindrical pressure vessels, about stresses at and stress indices for nozzle attachments, recommending stress indices for socket-welding fittings, measuring and analyzing stresses in cylinder-to-cylinder junctions, about stresses in flat plates with attached nozzles, and about stresses in and fatigue failure of forged tees. Summaries are also presented of work in progress dealing with the development of stress indices and flexibility factors for elbows, the development of code rules regarding isolated and closely spaced nozzles in cylindrical pressure vessels, procedures for analyzing the design of lugs attached to straight pipes, the analysis of stresses in flanged joints, load-limit and fatigue studies for elbows, and the elastic-response and fatigue-life behavior of forged tees.

25809 (RISO-M—1837) **A study of abnormal occurrence reports.** Taylor, J.R. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sep 1975. 32p. INIS.

A detailed study of failure and occurrence reports from five U.S. nuclear reactors is presented. Data concerning the frequency of failure causes and multifailure incidents are given. Methods of failure classification are discussed.

25810 An apparatus for controlling the filling of capsules with a gas containing a radioactive tracer. Bermann, F.; Chuiton, R.; Pages, J.P.; Prigent, R.; Riche, F.; Wacongne, M. (to CEA). French Patent 2,238,537/A/. 25 Jul 1973. 12p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to an apparatus for controlling the filling of capsules with a gas containing a radioactive tracer. Said apparatus is characterized in that it comprises a cylinder, or barrel for storing said capsules, means for causing said cylinder to rotate step by step means for introducing each capsule into a scintillator associated with a photo-multiplier, and means for driving the capsules towards one of the storage stations corresponding to insufficient, normal and too high filling rates, respectively.

25811 Plastic deformation and fracture behavior of zircaloy-2 fuel cladding tubes under biaxial stress. Maki, H.; Ooyama, M. (Hitachi Ltd., Ibaraki (Japan). Hitachi Research Lab.). *J. Nucl. Sci. Technol. (Tokyo);* **12**: No. 7, 423-435(Jul 1975).

Various combinations of biaxial stress were applied on five batches of recrystallized zircaloy-2 fuel cladding tubes with different textures; elongation in both axial and circumferential directions of the specimen was measured continuously up to 5% plastic deformation. The anisotropic theory of plasticity proposed by Hill was applied to the resulting data, and anisotropy constants were obtained through the two media of plastic strain loci and plastic strain ratios. Comparison of the results obtained with the two methods proved that the plastic strain loci provide data that are more effective in predicting quantitatively the plastic deformation behavior of the zircaloy-2 tubes. The anisotropy constants change their value with progress of plastic deformation, and judicious application of the effective stress and effective strain obtained on anisotropic materials will permit the relationship between stress and strain under various biaxialities of stresses to be approximated by the work hardening law. The test specimens used in the plastic deformation experiments were then stressed to fracture under the same combination of biaxial stress as in the proceeding experiments, and the deformation in the fractured part

was measured. The result proved that the tilt angle of the c-axis which serves as the index of texture is related to fracture ductility under biaxial stress. Based on this relationship, it was concluded that material with a tilt angle ranging from 10° to 15° is the most suitable for fuel cladding tubes, from the viewpoint of fracture ductility, at least in the case of unirradiated material.

25812 Nuclear reactor having control-rod retaining means. Frisch, E.; Andrews, H.N. (to Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Canadian Patent 972482. 5 Aug 1975. 22p.

Available from Commissioner of Patents, Ottawa.

A nuclear reactor has control rods which may be operated between control positions and retracted positions by linearly-movable elements or drive means. In the retracted position, a control rod or a group of control rods may be retained by latches, the lower tips of which enter a groove in a linearly-movable element or drive means. The latches are movable between a released position and a restraining position. The latches are made of magnetic steel and are maintained in the restraining position by permanent-magnet means which are operable between a coupled magnetic position wherein the drive means is maintained in the restraining condition and a decoupled position wherein the latches may release the associated drive means. Such operation of the magnet is in response to movement of a missile shield associated with the nuclear reactor.

25813 Fuel bundle and control element assembly handling mechanism. Schukei, G.E. (to Combustion Engineering, Inc.). Canadian Patent 972875. 12 Aug 1975. 11p.

Available from Commissioner of Patents, Ottawa.

A novel fuel bundle and control element assembly handling mechanism of a unitary construction. Mounted on the fuel lifting assembly of a refueling machine is a hydraulic control element assembly holding mechanism. A fuel bundle grapple mechanism passes through the fuel lifting assembly and is independently, vertically controllable with respect to the lifting assembly from a location on the refueling machine. Thus, the control element assembly and the fuel bundle may be gripped and manipulated independently, yet due to the interrelation of the grapple mechanisms, the control element assembly can be made to remain within the refueling machine lifting assembly during the refueling process.

25814 Pressure vessel penetration technique. Bevilacqua, F.; Groves, M.D. (to Combustion Engineering, Inc.). Canadian Patent 974669. 16 Sep 1975. 26p.

Available from Commissioner of Patents, Ottawa.

Hydraulic control lines pass through a pressure vessel head via bolted inner and outer flanges having a plurality of passages. Removal of the head for refueling is facilitated thereby.

25815 Fuel assembly hold-up device. Anthony, A.J.; Hutchinson, J.J.; Klumb, R.H. (to Combustion Engineering, Inc.). Canadian Patent 974667. 16 Sep 1975. 13p.

Available from Commissioner of Patents, Ottawa.

A hold-up device for nuclear reactor fuel assemblies which precludes the possibility of axial movement of the assemblies due to hydraulic forces under all thermal and flow conditions in the reactor core region. The fuel assembly is spring loaded against the upper guide structure , and supported so as to allow significant thermal expansion differential between the assembly and its support structure.

FUEL ELEMENTS

REFER ALSO TO CITATION(S) 25451

25816 (INIS-mf—3025, pp 5p, Paper NS(75)3.1) **Nuclear fuel as a quality assurance problem.** Smith, R.D. 1975.

From 3. nordic seminar on nuclear power plants quality assurance; Elsinore, Denmark (3 Dec 1975).

Published in summary form only.

In Nuclear power plants quality assurance.

25817 (KURRI-TR—123, pp 28-29) **Failed fuel detection from viewpoint of fuel inspection.** Aoki, T. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

The cause of the failed fuel problem is discussed from the viewpoint of the inspection in fuel processing. Especially the problem of (1) the qualification of cladding and (2) the qualification of fuel rod welding are mentioned in detail.

25818 (KURRI-TR—123, pp 2-4) **Cause of fuel failure and release of fission products.** Mishima, Y. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

Various causes of fuel failure, especially under normal operating conditions as well as transient conditions have been discussed. The considerations given in fuel designing to prevent power reactor fuels from failure are reviewed first, followed by the description about fission products released from the defected fuel.

25819 (KURRI-TR—123, pp 30-32) **Failed fuel detection from standpoint of a manufacturing company.** Suzuki, E. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

Needs for the installation of the FFD system depends on the reactor type, circumstances of fuel failure during operation and whether the reactor is commercial, prototype or experimental. And the needs also depends on whether the refueling is carried out on-power or off-power. For on power refueling FFDL gives important information to remove the just failed fuel at the earliest stage. Development and application of technology of failure diagnosis on reactor plants are also attractive for FFD and fuel failure prevention. Experiences on R and D are described for the FFD system of JOYO(FBR) and incipient failure diagnosis such as acoustic method, noise analysis method concerning coolant temperature fluctuation, reactivity balance method etc..

25820 (KURRI-TR—123, pp 8-18) **Failed fuel detection and location system, (2).** Mochizuki, K. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

111 refs.

In Study meeting on failed-fuel detectors.

A review is made on the failed fuel detection and location systems installed at reactors and in-pile loops in the world. Explained as the key problems to be studied further, are the anomaly diagnosis based on multiple signals, early warning of the anomalies, quantitative measurement of the failure and its threshold, FFDL for vented fueled reactor, and minimization of the complexity of in-core instrumentation. A list of reference reports, preprints and patents related to the system are attached.

25821 (KURRI-TR—123, pp 5-7) **Failed fuel detection and location system, (1).** Sekiguchi, A. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

The general remarks on the failed fuel detection systems are presented. Several detection systems are explained and their characteristics are discussed, for example, the delayed neutron method, the precipitation method and the β-γ rays measuring technique in the cover gas.

25822 (LA-UR—76-621) **Nondestructive examination program for unclad carbon-composite reactor fuel elements.** Fullbright, H.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 8p. (CONF-760903—2). Dep. NTIS $3.50.

From 8. world conference on nondestructive testing; Cannes, France (6 Sep 1976).

The Los Alamos Scientific Laboratory has been active for the past twenty years in the development and testing of graphitic-based high temperature reactor fuel elements. The initial involvement was in the field of nuclear propulsion systems. Project Rover began as a program to develop a nuclear-powered, hydrogen-propelled rocket engine. The basic fuel element for the Rover Program became uranium-loaded graphite. The enriched uranium fuel was incorporated into the graphite matrix as uranium oxide, later as pyrolytic-carbon coated uranium dicarbide microspheres, and, most recently, as a solid solution of uranium carbide and zirconium carbide. The fuel element matrix was protected from the hydrogen propellant/coolant by a chemical vapor deposited coating of refractory carbides such as niobium carbide, zirconium carbide, and tantalum carbide. The performance of these fuel elements was established through actual tests up to a sustained power level of about 3000 MW. The Ultra High-Temperature Reactor Experiment, UHTREX, utilized uranium-loaded graphite fuel elements in a demonstration high-temperature process-heat nuclear reactor. This system operated at temperatures in excess of 1500°K using helium as the cooling medium. The performance of the graphitic fuel elements again proved excellent. Presently, the Los Alamos Scientific Laboratory is developing fuel elements for possible use in the Argonne National Laboratory TREAT reactor. This report describes the nondestructive examination program for these experimental fuel elements.

25823 Fuel assemblies for nuclear reactors. Leonard, B.H. Jr. US Patent 3,923,596. 2 Dec 1975. Filed date 11 Jan 1960. 4p.

A description is given of a fuel assembly for a nuclear reactor comprising a plurality of elongated plate-like fuel bearing elements of the same length and width, paired longer than they are wide and assembly spacer members having means defining opposed spaced notches for receiving the side edges of said elongated plate-like fuel bearing elements, and means for securing said plate-like fuel bearing elements to said paired assembly spacer members with the side edges of said plate-like elements engaged in opposite notches in said paired assembly spacer elements so as to secure said fuel bearing elements in side by side spaced relation in a staggered arrangement transversely so as to conform to a diamond shaped profile in which opposite sides are parallel and opposite angles are substantially 60^0 and substantially 120^0.

25824 Manufacture of first shortened fuel elements by vibration compacting of uranium dioxide produced by the sol-gel method. Landspersky, H.; Urbanek, V. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). *Jad. Energ.*; **22**: No. 3, 104-106(Mar 1976). (In Russian).

Letter-to-the-editor.

25825 Nickel container of highly-enriched uranium bodies and sodium. Zinn, W.H. (to Energy Research and Development Administration). US Patent 3,947,320. 30 Mar 1976. Filed date 1 Apr 1953. 4p.

PAT-APPL-346,084.

A fuel element comprises highly enriched uranium bodies coated with a nonfissionable, corrosion resistant material. A plurality of these bodies are disposed in layers, with sodium filling the interstices therebetween. The entire assembly is enclosed in a fluid-tight container of nickel.

25826 Getter for nuclear fuel elements. Ross, W.T.; Williamson, H.E. (to General Electric Co.). US Patent 3,969,185. 13 Jul 1976. Filed date 9 May 1973. 10p.

A nuclear fuel element for use in the core of a nuclear reactor is disclosed and has disposed therein an improved getter capable of gettering reactive gases including a source of hydrogen. The getter comprises a composite with a substrate having thereon a coating capable of gettering reactive gases. The substrate has a greater coefficient of thermal expansion than does the coating, and over a period of time at reactor operating temperatures any protective film on the coating is fractured at various places and fresh portions of the coating are exposed to getter reactive gases. With further passage of time at reactor operating temperatures a fracture of the protective film on the coating will grow into a crack in the coating exposing further portions of the coating capable of gettering reactive gases.

25827 Nuclear fuel element. Thompson, J.R.; Rowland, T.C. (to General Electric Co.). US Patent 3,969,186. 13 Jul 1976. Filed date 11 Feb 1974. 8p.

A nuclear fuel element for use in the core of a nuclear reactor is disclosed. A heat conducting, fission product retaining metal liner of a refractory metal is incorporated in the fuel element between the cladding and the nuclear fuel to inhibit mechanical interaction between the nuclear fuel and the cladding, to isolate fission products and nuclear fuel impurities from contacting the cladding and to improve the axial thermal peaking gradient along the length of the fuel rod. The metal liner can be in the form of a tube or hollow cylindrical column, a foil of single or multiple layers in the shape of a hollow cylindrical column, or a coating on the internal surface of the cladding. Preferred refractory metal materials are molybdenum, tungsten, rhenium, niobium and alloys of the foregoing metals.

CONTROL SYSTEMS

25828 (JAERI-M—6113) **Reference design of the experimental multi-purpose high-temperature gas-cooled reactor. Nuclear parametric lattice study for design of the control rods.** Shindo, R. (Japan Atomic Energy Research Inst., Tokyo). May 1975. 53p. (In Japanese). INIS.

Determination of the dimensions of control rods and their arrangement in the core is fundamental in reactor design from the viewpoints of reactivity, and power distribution control. It is not easy, however, because of the many restrictions and intuitive design of the control rods confuses the total design of reactor, itself. Nuclear parametric studies have been made in design of the control rods, preliminarily under two conditions, i.e., of fuel element resulting from the nuclear parametric study of fuel lattices and control rods inserted in the core uniformly. The points to be noted in control rod design are as follows; (1) Fundamental is to plan the detailed reactivity balance in the reactor and thereby determine the diameter of control rods and their arrangement in the core, in conforming with the structural design of fuel elements and reactor core. (2) The thickness and boron concentration of control rods must be flexible ones, because of readjustment after completion of the reactor design. (3) The reactivity to be compensated with twin-control-rods in the core is large, compared with that of the uniform single-control rod arrangement, for the fuel elements and reactor core acceptable in structural design. (4) The design of burnable poison must be performed, considering not only the reduction of reactivity to be compensated with the control rods but also the recovery of reactivity from the consumption of burnable poison with fuel burnup.

25829 Method for the automatic control of a nuclear reactor. Loving, J.J. (to Westinghouse Electric Corp.). French Patent 2,241,852/A/. 15 Jul 1974. 21p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France); priority claim: 13 Jul 1973, USA.

The method is characterized in that it comprises the steps of automatically introducing detectors, or sensors, by group into the reactor core zone during the normal power output according to a pre-determined intermittent timing program, moving said detectors along a pre-determined path while they are thus being introduced into the core zone, and recording the output signals of said detectors with respect to their positions. The invention can be applied to the control of nuclear reactors.

25830 Sodium boiling detection in LMFBRs by acoustic-neutronic cross correlation. Wright, S.A. Seattle; Univ. of Washington (1975). 181p. University Microfilms Order No. 76-17,692.

Thesis (Ph. D.).

The acoustic and neutronic noise signals caused by boiling are the signals primarily considered likely to detect sodium boiling in an LMFBR. Unfortunately, these signals may have serious signal-to-noise problems due to strong background noise sources. Neutronic-acoustic cross correlation techniques are expected to provide a means of improving the signal-to-noise ratio. This technique can improve the signal-to-noise ratio because the neutronic and acoustic signals due to boiling are highly correlated near the bubble repetition frequency, while the background noise sources are expected to be uncorrelated (or at most weakly correlated). An experiment was designed to show that the neutronic and acoustic noise signals are indeed highly correlated. The experiment consisted of simulating the void and pressure effects of local sodium boiling in the core of a zero-power reactor (ARK). The resulting neutronic and acoustic noise signals were cross correlated and Fourier analyzed. The analysis showed that the neutronic and acoustic noise signals caused by boiling are almost perfectly correlated in a wide frequency band about the bubble repetition frequency. Theoretical models were developed to aid in the interpretation of the experimental results. These models agreed well with the experiment, and also showed that the near perfect correlation was caused by a linear functional relationship between the bubble volume and the acoustic noise.

25831 The control of PWR power stations: the Bugey 2 example. Durr, M. (Electricite de France, 69 - Lyon. Region d'Equipement). *Onde Electr.*; **55**: No. 8, 443-448(Oct 1975). (In French).

From One-day meeting on electronic instrumentation for nuclear reactor control; Paris, France (18 Dec 1974).

Options relative to "Electricite de France" reactor control (control team, automatization, control room design) are presented. Compliance with the USAEC regulations and safety criteria imposes requirements with respect to safety, organization, priorities and emergency station. Technological choices are explained: relaying, tensions, design of automatic systems, regulation, as well as choices of standardized devices and systems.

25832 Nuclear reactor control and electronic equipment development. Furet, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). *Onde Electr.*; **55**: No. 8, 437-439(Oct 1975). (In French).

From One-day meeting on electronic instrumentation for nuclear reactor control; Paris, France (18 Dec 1974).

After some ideas about nuclear energy in France, the conference program is indicated. Then reactor control in general and electronic instrumentation development are explained.

25833 On-line reactor surveillance based on multivariate analysis of noise signals. Piety, K.R. Knoxville, TN; Univ. of Tennessee (1976). 134p. University Microfilms Order No. 76-17,737.

Thesis (Ph. D.).

A minicomputer-based system for monitoring signals from nuclear power plants to provide advanced warning of anomalous conditions has been developed and implemented for on-line applications. A characterization of the reactor state is developed from

the analysis of noise signals. During an observation period when normal conditions prevail, the surveillance system utilizes these noise characterizations to form a statistical description of normal reactor behavior. At the conclusion of this observation period, the system examines each new incoming characterization to determine if it differs significantly from the normal description. The overall design of the surveillance system is discussed with the perspective of applications in nuclear power plants. The theoretical basis for the anomaly detection procedure is presented. A detailed description of the implementation of these techniques on a minicomputer is also provided. The performance of the surveillance system has been evaluated extensively. Its effectiveness was demonstrated in three on-line tests. The system proved to be sensitive to plant conditions and experienced negligible difficulty with false alarms.

25834 Detection of void fluctuations in reactor coolant channels by neutron noise analysis. Lu, J.T.H. Ames, IA; Iowa State Univ. of Science and Tech. (1976). 102p. University Microfilms Order No. 76-18,284.

Thesis (Ph. D.).

A neutron transmission method has been used to study the response of a detector to void fluctuations in an open coolant channel. Measurements of the stochastic component of the neutron beam, using air or steam voids, have been interpreted in terms of probability density functions and auto-power spectral densities. The results have been found to be very sensitive to the characteristics of the void generation, motion, and the pressure head in the channel. A theoretical expression which describes the transmission of thermal neutrons through a water channel containing fluctuating voids has been developed. The characteristics of this equation confirm that the relationship between the detector response and void fluctuations is nonlinear. The probability density functions of the calculated detector response, based on Gaussian and sinusoidal void amplitude distributions, compare favorably with the experimental data.

25835 Thermal detectors of mixed reactor radiation. Kott, J. *Jad. Energ.*; **22**: No. 3, 107-108(Mar 1976). (In Czech).

The so-called point values are defined of neutron flux and power density serving the determination of the distribution function of neutron flux within the entire core volume. Continuous measurement of the said values during reactor operation remains a significant technical problem. The principle of function and the detector construction are an important factor therefor. Comparative calorimeter measurements were conducted by IAEA in Grenoble in 1970 and by Poland and Czechoslovakia in Swierk in 1972. A special measuring set was developed consisting of 5 uranium calorimetric detectors developed by SKODA Works, Czechoslovakia for use in power reactors. The comparison of calorimetric and beta emission techniques shows that for prospective high temperature reactors thermal detectors seem to be the only suitable sensors for continuous in-pile measurement of the absolute values of reactor radiation. Miniaturization of reactor calorimeters is a necessary pre-requisite. The problems of development involved are to be coped with within five years.

25836 Quick release latch for reactor scram. Johnson, M.L.; Shawver, B.M. (to Energy Research and Development Administration). US Patent 3,941,413. 2 Mar 1976. Filed date 9 Apr 1975. 8p.

PAT-APPL-566,485.

A simple, reliable, and fast-acting means for releasing a control element and allowing it to be inserted rapidly into the core region of a nuclear reactor for scram purposes is described. A latch mechanism grips a coupling head on a nuclear control element to connect the control element to the control drive assembly. The latch mechanism is closed by tensioning a cable or rod with an actuator. The control element is released by de-energizing the actuator, providing fail-safe, rapid release of the control element to effect reactor shutdown. A sensing rod provides indication that the control element is properly positioned in the latch. Two embodiments are illustrated, one involving a collet-type latch mechanism, the other a pliers-type latch mechanism with the actuator located inside the reactor vessel.

25837 Control and shim rod arrangement with moveable plugs. Smith, M.H. (to Energy Research and Development Administration). US Patent 3,947,321. 30 Mar 1976. Filed date 2 Apr 1946. 4p.

PAT-APPL-658,947.

This invention relates to a control and shim rod arrangement for a nuclear reactor. A second shield of concrete completely encloses a biological shield. Moveable plugs are mounted in the shield.

25838 Detection of fuel rod leakage. Worlton, D.L.; Robinson, D.L. (to Exxon Nuclear Co., Inc.). US Patent 3,969,187. 13 Jul 1976. Filed date 6 Dec 1973. 8p.

Nuclear reactor fuel rod leakage is determined by measurement of vibrational characteristics of a resilient, flexible means sealed within the upper end caps of the fuel elements. The flexible means, which is preferably a metallic diaphragm, is set into motion by the impact of an internal metal rod which is operated by an external magnetic field, thereby permitting an indication of the pressure inside a fuel element without disturbing the welded assembly. The metal rod is activated and the vibration measurements are made through the use of a special tool which fits near the end cap of the fuel element to be tested.

ENVIRONMENTAL ASPECTS

25839 (CONF-760816—5) Effects of duct configuration on flow and temperature structure in sodium-cooled 19-rod simulated LMFBR fuel bundles with helical wire-wrap spacers. Wantland, J.L.; Fontana, M.H.; Gnadt, P.A.; Hanus, N.; MacPherson, R.E.; Smith, C.M. (Oak Ridge National Lab., Tenn. (USA)). 1976. 15p. Dep. NTIS $3.50.

From National heat transfer conference; St. Louis, Missouri, United States of America (USA) (8 Aug 1976).

Thermal-hydrodynamic testing of sodium-cooled 19-rod simulated LMFBR fuel bundles is being conducted at the O ak Ridge National Laboratory in the Fuel Failure Mockup (FFM), an engineering-scale high-temperature sodium facility which provides prototypic flows, temperatures and power densities. Electrically heated bundles have been tested with two scalloped and two hexagonal duct configurations. Peripheral helical flows, attributed to the spacers, have been observed with strengths dependent upon the evenness and relative sizes of the peripheral flow areas. Diametral sodium temperature profiles are more uniform with smaller peripheral flow areas.

25840 (PB—241496) Power facility siting in the State of Illinois. Part II. Environmental impacts of large energy conversion facilities. Final report. MacFarlane, D.R.; Hoglund, B.M.; Roberts, P.A.; Yates, J.J. (Environmental Technology Assessment, Inc., Oak Brook, Ill. (USA)). Mar 1975. 312p. NTIS $9.25.

See also Part I, PB—228632.

The necessary technical information required for a rational approach to evaluating the environmental impact of large energy facilities such as power plants and coal gasification plants is analyzed. The report provides a set of evaluative tools that will allow environmental impacts, costs and benefits to be quantified in a way which should expedite rational decisions concerning alternative energy facility sites. The information presented also provides guidelines for applicants required to submit environmental impact statements. (GRA)

SITING

25841 (INIS-mf—3031) Underground siting of nuclear power plants. Summary of a project study. (Norges Vassdrags- og Elektrisitetsvesen, Oslo. Direktoratet for Statskraftverkene). Dec 1975. 54p. (In Norwegian). INIS.

7 references.

The study covers the technical and economic factors involved in placing a PWR type reactor in an underground containment in bedrock under the conditions found in Norway. Experience with underground halls for hydroelectric plants indicates that such a project is within the scope of established technology, that is with a span of 60 x 60m. The safety of such a plant is evaluated with reference to such design basis accidents as aircraft crashes, earthquakes, floods, fire, maloperation, functional failures and component failures compared with similar accidents with conventional containment. It is concluded that the probability and consequences of such 'traditional' accidents are essentially the same in underground and surface plants, while rock falls are peculiar to underground plants and are not at present possible to quantify. An underground site affords better protection against war risks and aircraft crashes. The time schedule for construction is analysed and it is found to require about two years more than a surface plant. The total cost of an underground plant, including interest charges, is estimated to be 23.6 percent higher than that of a surface plant. In conclusion the corresponding Swedish CDL study is briefly evaluated.

25842 (NGI—74605-2) Study of feasibility, design and cost of excavations for underground siting of nuclear power plants. (Norges Geotekniske Institutt, Oslo). Feb 1976. 80p. INIS.

Report prepared for Norges Vassdrags- og Elektrisitetsvesen - Statskraftverkene. 15 references.

A study conducted for the State Power Board on underground siting of nuclear power plants is presented. The report is divided into two chapters, both concerning the technical aspects

of large underground openings. The first chapter gives a brief general survey of the problems involved, and the second outlines the technical aspects of a PWR project at a specific site. Details are given in 8 appenices and arrangement drawings.

25843 La scelta dei siti per gli impianti nucleari. (Congress on site selection for nuclear reactors, Trisaia, Italy, September 15—16, 1972). Rome; Comitato Nazionale Energia Nucleare (1972). 242p. (In Italian). (CONF-7209136—).

From Congress on site selection for nuclear reactors; Trisaia, Italy (15 Sep 1972).

Twenty-two papers on the problems of reactor site selection are included. All papers are in Italian.

RADIOACTIVE EFFLUENTS

25844 (GA-A—13461) **Review of tritium behavior in HTGR systems.** Gainey, B.W. (General Atomic Co., San Diego, Calif. (USA)). 30 Apr 1976. Contract E(04-3)-167. vp. Dep. NTIS $6.75.

The available experimental evidence from laboratory and reactor studies pertaining to tritium production, capture, release, and transport within an HTGR leading to release to the environment is reviewed. Possible mechanisms for release, capture, and transport are considered and a simple model was used to calculate the expected tritium release from HTGRs. Comparison with Federal regulations governing tritium release confirm that expected HTGR releases will be well within the allowable release limits. Releases from HTGRs are expected to be somewhat less than from LWRs based on the published LWR operating data. Areas of research deserving further study are defined but it is concluded that a tritium surveillance at Fort St. Vrain is the most immediate need.

THERMAL EFFLUENTS

25845 Echauffement des eaux par les centrales nucleaires. V. Les refrigerants atmospheriques. (Heating of water by nuclear power stations. V. Air coolants). Paris; Electricite de France (31 Jan 1975). 10p. (In French).

Distributed by Centre de Documentation Nucleaire, EDF-Direction de l'Equipement, 29 Avenue de Messine, 75008 Paris.

Certain unresolved difficulties lead to a preference for wet coolants, where the latent heat of water enables power to be evacuated with an air flow of 30,000 m³/s. Most of the calories, instead of heating the surrounding air, convert the water into steam. In the wet coolant almost 70% of the heat transfer takes place by evaporation: the air is heated and takes up water vapour as it passes through the coolant; at the outlet the water vapour often condenses and produces a more or less heavy visible plume. The air flow in the coolant is obtained either by means of a high stack which produces a so-called natural draft by chimney effect, or by the use of ventilators which avoid the need for stacks but sometimes raise awkward acoustical problems. Wet coolants with natural draft are examined.

25846 Echauffement des eaux par les centrales nucleaires. Note no.6. Transit des eaux de refrigeration dans les condenseurs. (Heating of water by nuclear power stations. VI. Transit of cooling waters in the condensers). Paris; Electricite de France (18 Feb 1975). 8p. (In French).

Distributed by Centre de Documentation Nucleaire, EDF-Direction de l'Equipement, 29 Avenue de Messine 75008 Paris.

A nuclear power station is a thermal machine working between a hot source and a cold source. Like all thermal machines its yield depends on the hot and cold temperatures and is about 30% to 32% for PWR and BWR stations and 38 to 40% for breeders. The "cold source" part of the station consists mainly of a condenser; the heat flux from the steam condensing at the turbine outlet is transferred to a flow of cooling water taken from a natural source (sea, river or lake) or passing in closed circuit through a coolant. Only so-called open circuits are discussed, with special reference to stations built on the sea coast.

RESEARCH, TEST, EXPERIMENTAL, ZERO-POWER, AND TRAINING REACTORS AND SUBCRITICAL ASSEMBLIES

REFER ALSO TO CITATION(S) 25761, 25822, 25867, 26123

25847 (AAEC/S—17, pp 6.1-6.24) **Exponentials and reactors. Chapter 6.** McCulloch, D.B. Dec 1975.

In Summer school, 1976. Down but never out - the mathematics and computation of exponentials arising in the fields of physics, chemistry, biology.

Physical processes important to the behaviour of nuclear reactors are briefly outlined, leading to a description of the 100 kW research reactor, Moata. The simple equations for neutron-induced artificial radioactivity are derived, and applied to a Moata irradiation experiment in which a target foil is identified by measurement of the resulting radioactive half-life.

25848 (BARC/I—337) **Thickness measurement of CIRUS calandria tubes by eddy-current method.** Gupta, S.K.; Chaudhuri, H.; Prasad, R. (Bhabha Atomic Research Centre, Bombay (India)). 1975. 9p. INIS.

8 figures.

To plan the replacement of the calandria of CIRUS reactor, it is necessary to check the magnitude of reduction that has taken place in the thickness of the tubes. An instrument has been developed which can sense thickness reduction to a maximum extent of 20 thousandths.

25849 (CONF-760503—6) **On-line sodium and cover as purity monitors gas operating tools at EBR-II.** Smith, C.R.F.; Richardson, W.J.; Holmes, J.T. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 8p. Dep. NTIS $3.50.

From International conference on liquified metal technology in energy production; Champion, Pennsylvania, United States of America (USA) (3 May 1976).

Plugging temperature indicators, electrochemical oxygen meters and hydrogen diffusion meters are the on-line sodium purity monitors now in use at EBR-II. On-line gas chromatographs are used to monitor helium, hydrogen, oxygen and nitrogen impurities in the argon cover gases. Monitors for tritium-in-sodium and for hydrocarbons-in-cover gas have been developed and are scheduled for installation in the near future. An important advantage of on-line monitors over the conventional grab-sampling techniques is the speed of response to changing reactor conditions. This helps us to identify the source of the impurity, whether the cause may be transient or constant, and take corrective action as necessary. The oxygen meter is calibrated monthly against oxygen in sodium determined by the vanadium wire equilibration method. The other instruments either do not require calibration or are self-calibrating. The ranges, sensitivity and response times of all of the on-line purity monitors has proven satisfactory under EBR-II operating conditions.

25850 (CONF-760503—7) **EBR-II water-to-sodium leak detection system.** Wrightson, M.M.; McKinley, K.; Ruther, W.E.; Holmes, J.T. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 9p. Dep. NTIS $3.50.

From International conference on liquified metal technology in energy production; Champion, Pennsylvania, United States of America (USA) (3 May 1976).

The water-to-sodium leak detection system installed at EBR-II in April, 1975, is described in detail. Topics covered include operational characteristics, maintenance problems, alarm functions, background hydrogen level data, and future plans for refinements to the system. Particular emphasis is given to the failures of eight of the ten leak detectors due to sodium-to-vacuum leakage, and the program anticipated for complete recovery of the system.

25851 (CONF-760503—9) **Sodium technology at EBR-II.** Holmes, J.T.; Smith, C.R.F.; Olson, W.H. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 11p. Dep. NTIS $3.50.

From International conference on liquified metal technology in energy production; Champion, Pennsylvania, United States of America (USA) (3 May 1976).

Since the installation of purity monitoring systems in 1967, the control of the purity of the primary and secondary sodium and cover gas systems at the Experimental Breeder Reactor II (EBR-II) has been excellent. A rigorous monitoring program is being used to assure that operating limits for more than 25 chemical and radioactive impurities are not exceeded. The program involves the use of sophisticated sampling and analysis techniques and on-line monitors for both sodium and cover gas systems. Sodium purity control is accomplished by essentially continuous cold trapping of a small side stream of the total circulating sodium. The cold traps have been found to be very effective for the removal of the major chemical impurities (oxygen and hydrogen) and tritium but are almost ineffective for ^{131}I and ^{137}Cs that enter the sodium from fuel cladding breaks. Purging with pure argon maintains the cover gas purity.

25852 (CONF-760503—12) **Analysis of carbon transport in the EBR-II and FFTF primary sodium systems.** Snyder, R.B.; Natesan, K.; Kassner, T.F. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 9p. Dep. NTIS $3.50.

From International conference on liquified metal technology in energy production; Champion, Pennsylvania, United States of America (USA) (3 May 1976).

An analysis of the carburization-decarburization behavior of austenitic stainless steels in the primary heat-transport systems of the EBR-II and FFTF has been made that is based upon a kinetic model for the diffusion process and the surface area of steel in contact with flowing sodium at various temperatures in the two systems. The analysis was performed for operating conditions that result in sodium outlet temperatures of 474 and 566°C in the FFTF and 470°C in the EBR-II. If there was no external source of carbon to the system, i.e., other than the carbon initially present in the steel and the sodium, the dynamic-equilibrium carbon concentrations calculated for the FFTF primary sodium were approximately 0.025 and approximately 0.065 ppm for the 474 and 566°C outlet temperatures, respectively, and approximately 0.018 ppm for the EBR-II primary system. The analysis indicated that a carbon-source rate of approximately 250 g/y would be required to increase the carbon concentration of the EBR-II sodium to the measured range of approximately 0.16—0.19 ppm. An evaluation of possible carbon sources and the amount of carbonaceous material introduced into the reactor cover gas and sodium suggests that the magnitude of the calculated contamination rate is reasonable. For a 566°C outlet temperature, carbonaceous material would have to be introduced into the FFTF primary system at a rate approximately 4—6 times higher than in EBR-II to achieve the same carbon concentration in the sodium in the two systems. Since contamination rates of approximately 1500 g/y are unlikely, high-temperature fuel cladding in the FFTF should exhibit decarburization similar to that observed in laboratory loop systems, in contrast to the minimal compositional changes that result after exposure of Type 316 stainless steel to EBR-II sodium at temperatures between approximately 625 and 650°C.

25853 (CONF-760905—2) **Inelastic finite element cyclic analysis of a nozzle-to-cylinder intersection.** Barsoum, R.S.; Loomis, R.W. (Combustion Engineering, Inc., Windsor, Conn. (USA)). 1976. 31p. Dep. NTIS $4.00.

From International joint pressure vessels and piping and petroleum mechanical engineering conference; Mexico City, Mexico (19 Sep 1976).

A finite element elastic-plastic and creep analysis of a nozzle-to-cylinder intersection subject to cyclic thermal shock, internal pressure, and mechanical loads is presented. The nozzle configuration is that of the intermediate heat exchanger (IHX) for the Fast Flux Test Facility (FFTF). The analysis was performed using the general purpose program MARC. Both the elastic and inelastic results of the analysis are presented. The intention of this study to analytically investigate the applicability of simplified ratchetting and creep-fatigue rules for LMFBR components, as a part of a program covering various geometries and loadings.

25854 (DP-MS—76-16) **Physics calculations for charge design at Savannah River.** Sharp, D.A. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1976. Contract AT(07-2)-1. 25p. (CONF-760622—33). Dep. NTIS $3.50.

From American Nuclear Society 1976 annual meeting; Toronto, Ontario, Canada (13 Jun 1976).

The physics calculations used at Savannah River for charge design are described. A standard computational system, composed of modular computer codes and a data base, is used for routine design studies. Its primary functions consist of lattice and charge analysis. The system is supplemented by empirical procedures to improve its accuracy. Auxiliary computational techniques are employed, along with the standard system, for design of new assemblies and charge types. With these supplements, the standard system is sufficiently accurate and efficient to meet the current design needs of Savannah River.

25855 (HEDL-TME—74-28) **Process engineering analysis of the FFTF cover gas monitoring systems: preliminary design.** Holt, F.E.; Miller, W.C. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1976. Contract E(45-1)-2170. 138p. AT.

The preliminary design of the on-line Cover Gas Monitoring Systems for the FFTF's Reactor and Closed Loop is described. The design is the culmination of a study of the analytical problems expected and the methods tested to circumvent them. The analytical models used to describe the parameters effecting radionuclide concentrations and the theory and experiments used to test elements of the design are presented. The design makes use of a plug of charcoal and a planar diode detector to partially separate the gases in the cover gas and to monitor the gamma emissions from the radionuclides. The charcoal causes the xenon and krypton gases contained in the argon cover gas to be concentrated relative to the interferring neon and argon. The planar detector situated alongside the charcoal is sized for greater counting efficiency of the xenon and krypton isotopes, rather than for those of neon and argon. Before the analysis, some delay of the gases is included to allow some decay of a short-lived isotope of neon which is expected to be present at a very high relative concentration.

25856 (INIS-mf—3046) **OECD Halden reactor project. 15. annual report, 1974.** (Nuclear Energy Agency, 75 - Paris (France)). 1974. 103p. INIS.

A major part of the current research programme is devoted to irradiation experiments with a wide variety of heavily instrumented test fuel assemblies in order to study the thermal and mechanical behavior of fuel rods through in-core measurements, in particular various forms of deformation of cladding and fuel as related to operational conditions and fuel rod design parameters. From these measurements mathematical models are being developed to explain quantitatively the deformation behavior, as well as the thermal properties of the fuel. During 1974, fifty-six instrumented fuel assemblies were irradiated in these experiments. Another major part of the Halden programme is aimed at the development and demonstration of advanced computer-based methods for plant and reactor core control, for safety and protection, and for overall supervision of nuclear power stations. Both the control methods themselves and the associated measurement and control apparatus are being elaborated, and during the year particular progress was made with the "OPCOM" process operator communication system.

25857 (JAERI-M—6107) **Operation report on the low temperature fissiochemical loop (LTFL), 5. Operations during the period of April 1973 to December 1974.** Sato, S.; Kobayashi, T.; Ikezoe, Y.; Shimizu, S.; Nakajima, H. (Japan Atomic Energy Research Inst., Tokyo). Apr 1975. 33p. (In Japanese). INIS.

During the period, the Low Temperature Fissiochemical Loop (LTFL) was operated 13 times, irradiating 71 capsules which contained 201 irradiation samples. The safety aspects were reviewed by the Committee on the Operation and Maintenance of Reactors, JAERI. A series of minor troubles have occurred with the capsule disconnecting mechanism, the pumping system for the capsule handling section, and the cooling water system of the helium compressor. Later the operations could be carried out without such a trouble, after solutions were worked out. Capsules of the improved designs (type 4B and 4C capsules) were used extensively, more than doubling the efficiency of irradiation operations, as compared to the records of the preceding 3 years. Maintenance works on the loop are described. The design of a new inner capsule has been developed. Its fabrication, assembly tests and the test of the pressure gage were generally successful. Reaction experiments are outlined. Some interesting results, concerning the effects of fission fragment irradiation, pressure, and reactant composition, have been obtained for reactions of nitrogen-ethylene system to produce hydrogen cyanide, ammonia-ethane system to produce ethylamine and carbon dioxide-propane system for efficient production of carbon monoxide.

25858 (KURRI-TR—123, pp 72-79) **Preliminary study on failed fuel detection in KUR.** Hayashi, S.A.; Kozuka, T.; Kanda, K. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

The Failed Fuel Detection is an important problem on the reactor safety and environment control. In this paper, the FFD systems for being in the Kyoto University Reactor have been described and the preliminary experiment of failed fuel detection have been performed with the irradiation of bare U-Al foils in an exposure loop at the side of the core. Fission products emerging into water were detected by mean of ion-exchanger with a neutron counting system and Br^{37}, Br^{88} and I^{137} nuclides of delayed neutron precursors were identified for the detection of defected fuel. Moreover, various problems caused in its application to this reactor and to the high flux reactor planning to construct (KUR-2) have been discussed.

25859 (KURRI-TR—123, pp 19-21) **Failed fuel detection system from viewpoint of reactor physics. (Design of high flux beam reactor and failed fuel detection).** Kanda, K. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

The significance of the failed fuel detection system is discussed from the viewpoint of reactor physics and reactor safety design, especially in the case for a high flux beam reactor, which is going to be built at Research Reactor Institute of Kyoto University. The present status of the gap between reactor physics and safety design problem is mentioned.

25860 (KURRI-TR—123, pp 64-71) **Fuel failure detection on JRR-2, JRR-3 and JRR-4.** Shirai, E. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

Fuel failure detectors (FFD) on JRR-2, JRR-3 and JRR-4 at Japan Atomic Energy Research Institute have been operated for about 10 years. During the operation, many kinds of experiments and modifications on FFD systems were performed, and fuel failures in JRR-3 and JRR-4 were detected by these FFD systems. The mechanism of these FFD systems and some typical examples of the fuel failure detections are described in this paper.

25861 (LA-UR—76-1432) **Research on plasma core reactors.** Jarvis, G.A.; Barton, D.M.; Helmick, H.H.; Bernard, W.; White, R.H. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 11p. (CONF-760646—1). Dep. NTIS $3.50.

From Symposium on uranium plasmas; Princeton, New Jersey, United States of America (USA) (10 Jun 1976).

Experiments and theoretical studies are being conducted for NASA on critical assemblies with one-meter diameter by one-meter long low-density cores surrounded by a thick beryllium reflector. These assemblies make extensive use of existing nuclear propulsion reactor components, facilities, and instrumentation. Due to excessive porosity in the reflector, the initial critical mass was 19 kg U(93.2). Addition of a 17-cm-thick by 89-cm-diameter beryllium flux trap in the cavity reduced the critical mass to 7 kg when all the uranium was in the zone just outside the flux trap. A mockup aluminum UF_6 container was placed inside the flux trap and fueled with uranium-graphite elements. Fission distributions and reactivity worths of fuel and structural materials were measured. Finally, an 85,000 cm^3 aluminum canister in the central region was fueled with UF_6 gas and fission density distributions determined. These results will be used to guide the design of a prototype plasma core reactor which will test energy removal by optical radiation.

25862 SLOWPOKE reactor. A low cost critical neutron producer. Evans, D.J.R.; Downs, W.E. (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Proc. Jpn. Conf. Radioisot.*; No. 11, 224-234(Aug 1974).

From 11. Japan conference on radioisotopes; Tokyo, Japan (13 Nov 1973).

The SLOWPOKE reactor is described, which is a small pool type reactor with thermal neutron fluxes ranging from 10^{11}-10^{12} n $cm^{-2}sec^{-1}$. It differs in many ways from conventional pool type, namely small critical mass, beryllium reflector and a closed reactor container. The reactor is designed as small and simply as possible, and consistently with safety and good operating practice. Access to the present model is via pneumatic irradiation tubes only, which limits the use of the facility to activation analysis, tracer production and training. (Mori, K.).

25863 First stage of the WWR-S reactor reconstruction. Kavan, K.; Listik, E.; Musilek, F.; Pittermann, P.; Slechta, M.; Vojta, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). *Jad. Energ.*; **22**: No. 3, 81-87(Mar 1976). (In Czech).

The technical development of the WWR-S reactor from its start-up in 1957 up to the present time is briefly described. The targets of the first stage of the facility reconstruction are formulated. This stage was accomplished in 1974. Attention is devoted to the description of refuelling and to some design details of the reactor core, of the control and protection system and finally to the experience with and the results of the reactor physical start-up. The volume of work carried out and described creates the pre-conditions for the successful materialization of the second stage of the reconstruction aimed at increasing of the reactor thermal output to 10 MW.

PLUTONIUM AND ISOTOPE PRODUCTION, CHEMONUCLEAR, MATERIALS TESTING, AND MATERIALS PROCESSING REACTORS

25864 (DP—1392) **DESIGN: a computer program to design SRP fuel and target assemblies.** Baker, W.H. (Savannah River Ecology Lab., Aiken, S.C. (USA)). Apr 1976. Contract AT(07-2)-1. 55p. Dep. NTIS $4.50.

The computer program DESIGN calculates optimum dimensions of fuel or target assemblies in the Savannah River Plant reactors to provide a desired coolant flow or calculates the total D_2O circulation and the assembly coolant flow given a reactor core size and set of assembly dimensions. The program solves by iterative procedures the equation for steady-state one-dimensional coolant flow in the assembly and reactor system and for steady-state one-dimensional (radial) heat flow in the tubes of the assembly. This report discusses the approach to assembly design, the equations used in the program, the logic for the solution of the equations, and, finally, the input and output for the program.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 26212

25865 (ANCR-NUREG—1303) **Temperature measurement on Zircaloy-clad fuel pins during high temperature excursions.** Meservey, R.H. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1976. Contract E(10-1)-1375. 40p. Dep. NTIS $4.00.

The development of a sheathed thermocouple suitable for attachment to zircaloy-clad fuel rods and for use during high temperature (2,800°F) excursions under loss-of-coolant accident conditions is described. Development, fabrication, and testing of the thermocouples is covered in detail. In addition, the development of a process for laser welding the thermocouples to fuel rods is discussed. The thermocouples and attachment welds have been tested for resistance to corrosion and nuclear radiation and have been subjected to fast thermal cycle, risetime, and blowdown accident tests.

25866 (ANL—76-16) **Final summary report of fuel-dynamics tests H2 and E4.** Doerner, R.C.; Rothman, A.B.; De Volpi, A.; Dickerman, C.E.; Deitrich, L.W; Stahl, D.; Murphy, W.F. (Argonne National Lab., Ill. (USA)). Feb 1976. Contract W-31-109-Eng-38. 86p. Dep. NTIS $5.00.

Results of two failure experiments using LMFBR-type fuel during simulated unprotected transient overpower accidents are reported and analyzed. In both experiments, a single fresh fuel pin in a Mark-IIA loop was subjected to a temperature-limited, step-reactivity irradiation in the TREAT reactor. Total energy was 490 MJ in Test H2 and 690 MJ in Test E4. Except for their timing, the sequence of events in the failure scenario was the same for both tests. Local coolant boiling began 25-50 msec before failure. Significant upward fuel flow in the center of the pin started as early as 100 msec before cladding failure. Cladding failure was due to melting after contact with molten fuel and occurred at the top of the fuel column. Formation of an outlet flow-channel blockage began about 10 msec after failure and was complete by 50 msec. Inlet blockage began later and was less extensive. No significant amount of fuel sweepout was observed. Fuel remains separated into a small group of 50-1000-μm fragments and a macroscopic group of chunks and clinkers. The final distribution of fuel remains may have resulted from a delayed fuel/steel interaction in the inlet region.

25867 (ANL-RDP—49) **Reactor development program progress report, March 1976.** (Argonne National Lab., Ill. (USA)). 7 May 1976. Contract W-31-109-Eng-38. vp. AT.

Progress is summarized in the following research and development areas: Experimental Breeder Reactor No. II, LMFBR Design Support, Instrumentation and Control, Reactor Physics, Reactor Safety, and Gas Cooled Fast Breeder Reactors.

25868 (BNL-NUREG—21259) **Analysis of GCFBR transients without scram.** Ludewig, H. (Brookhaven National Lab., Upton, N.Y. (USA)). Feb 1976. Contract E(30-1)-16. 39p. Dep. NTIS $4.00.

The analyses of four transients imposed on a Gas Cooled Fast Breeder Reactor (GCFBR) plant are presented. These calculations were carried out using the HELAP code, which is based on RELAP 3B. The transient imposed on the system is a design basis depressurization accident (DBDA) with no scram. Furthermore, the rupture size causing the depressurization was varied over a range from .6 ft^2 to zero. In the limit of no rupture the transient imposed on the system is due only to the transient behavior of the steam generator and circulator turbine during a DBDA. The following observations can be made, based on this work: (1) The time to clad failure as determined in this work is much shorter than in the previously published preliminary work. (2) In the case of no rupture, the agreement between the current analysis and the previously carried out analysis is better. (3) In the case of smaller rupture sizes the superheater tube wall is subject to rapidly rising temperatures and pressures. The latter rise would be strongly affected by the capacity of the safety and relief valves. These temperatures and pressure transients should be evaluated with the tube wall strength in mind, since a steam generator tube failure during such a transient would be undesirable.

25869 (BNWL—1962) **COBRA-IV-I: an interim version of COBRA for thermal-hydraulic analysis of rod bundle nuclear fuel elements and cores.** Wheeler, C.L.; Stewart, C.W.; Cena, R.J.; Rowe, D.S.; Sutey, A.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1976. Contract E(45-1)-1830. 267p. Dep. NTIS $9.00.

The COBRA-IV-I computer code uses the subchannel analysis approach to determine the enthalpy and flow distribution in rod bundles for both steady-state and transient conditions. The steady-

state and transient solution schemes used in COBRA-IIIC are still available in COBRA-IV-I as the implicit solution scheme option. In addition to these techniques, a new explicit solution scheme is now available which allows the calculation of severe transients involving flow reversals, recirculations, expulsion and reentry flows, with a pressure or flow boundary condition specified. Significant storage compaction and reduced running times have been achieved to allow the calculation of problems involving hundreds of subchannels.

25870 (BNWL-CC—816) **Design criteria for phase II dummy hydraulic core for containment systems experiment reactor simulator.** Henager, C.H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 3 Oct 1966. Contract E(45-1)-1830. 17p. Dep. NTIS $3.50.

The design of a Phase II dummy hydraulic core for the CSE reactor simulator is described. The core will be a scale model having features typical of PWR or BWR reactor cores, and will include control rods and associated support mechanisms, fuel elements, a thermal shield, top and bottom core guide and support plates, and flow baffles. The core and simulator vessel will be instrumented to provide measurement of temperature, static and differential pressures, forces on core components, and rarefaction wave pressures during high temperature, high pressure blowdown studies.

25871 (CONF-760905—3) **Decoupling of vibration systems.** Scavuzzo, R.J.; Lam, P. (Oak Ridge National Lab., Tenn. (USA)). 1975. Contract W-7405-eng-26. 34p. Dep. NTIS $4.00.

From International joint pressure vessels and piping and petroleum mechanical engineering conference; Mexico City, Mexico (19 Sep 1976).

The effects of decoupling a multimass subcomponent from a large structure are examined. An attempt is made to correlate the effects of decoupling with the modal mass of the subcomponent. Two methods are used to study these effects: (1) Determining the effect of the inertia of the subcomponent on the motion of the primary component. This effect is evaluated by studying the change in the spectrum response of the motion input to the substructure and (2) Investigating the effect of decoupling the multimass system on the natural frequencies of the system.

25872 (COO—2471-6) **Modeling of cladding and fuel motion in a loss of flow situation for GCFR safety analysis. Progress report 6, October 15, 1975—January 15, 1976.** Eggen, D.T. (Northwestern Univ., Evanston, Ill. (USA)). 15 Feb 1976. Contract E(11-1)-2471. 31p. Dep. NTIS $4.00.

The first experiments have been run using electrically heated, simulated fuel elements in an inert gas (argon) loop. The fuel elements have a chopped cosine power input and have a Pb/Sn alloy cladding. Single elements were used in the first two experiments with a step power pulse of about 1 kW/ft which was sufficient to melt the center of the clad within 8 to 10 sec. As the molten cladding entered the blanket (unheated) region, it froze within about 1 inch. The apparatus for the stainless steel pouring experiment is progressing. Additional models for freezing of molten cladding in colder regions are being analyzed and tested against the single tube pouring tests previously reported. Analytical routines are under development.

25873 (COO—2515-5) **Development of a lumped parametric model for scoping investigations of uncertainties in fast reactor probabilistic safety analysis. Progress report, January 1, 1976—March 31, 1976.** Ott, K.O.; Luck, L. (Purdue Univ., Lafayette, Ind. (USA)). 1976. Contract AT(11-1)-2515. 16p. Dep. NTIS $3.50.

The objective of the research program reported is to explore the possibility of the development of a novel reactor safety analysis methodology suitable for a parametric investigation of uncertainties in the progression of severe fast reactor accidents. The essential feature of this approach is a description of the reactor state by means of volumetric distributions. The description of volume of reactor materials, such as coolant, clad, and fuel, with temperature and in the case of fuel material, also with power, is termed a volumetric distribution. Stationary volumetric distributions are computed from detailed spatial temperature and power distributions of materials in the steady state reactor. Stationary volumetric distributions and other reactor physics quantities form the input for the reactor transient calculations in which the accident progression is described by the behavior of transient volumetric distributions. Progress during the reporting period was concerned with two areas: the further development and refinement of transient volumetric distributions and the formulation of the temperature worth distribution, which is needed in reactivity feedback calculations in conjunction with the transient volumetric distribution.

25874 (CREARE-TN—235) **Preliminary ECC delivery data at 1/15-scale. Quarterly progress report, January 1, 1976—March 31, 1976.** Block, J.A.; Crowley, C.J. (Creare, Inc., Hanover, N.H. (USA)). 7 May 1976. Contract AT(49-24)-0162. 38p. Dep. NTIS $4.00.

Preliminary test results in a 1/15-scale, cylindrical, elevated pressure, PWR-model test vessel are described. These tests form part of a program to develop an analytical and empirical model for plenum filling. During the quarter, countercurrent flow, lower plenum voiding, and super-heated-wall-with-countercurrent-flow tests were conducted. Sample data comparing trends with past data in a different geometry are presented. Good agreement is demonstrated. Special interest items of pressure drop measurements, oscillatory water delivery, steam and water injection sequencing and elevated pressure control are discussed.

25875 (GEAP—14034-6) **Radiological assessment models. Sixth quarterly report, December 1975—February 1976.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Mar 1976. Contract E(04-3)-893. 48p. AT.

Progress during December 1975, January and February 1976, in the Radiological Assessments Program is reported. The objectives of the program are to develop models for analyzing and evaluating postulated radiological sources, aerosol dynamics, sodium fires, and radiological dosages arising from hypothetical core disruptive accidents in liquid metal fast breeder reactors.

25876 (HEDL-SA—936) **Computational models for fast reactor safety analysis.** Waltar, A.E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 18 Apr 1975. 64p. (CONF-7504108—1). Dep. NTIS $4.50.

From Seminar to the nuclear engineering department; Ann Arbor, Michigan, United States of America (USA) (18 Apr 1975).

A review is presented of the development of mathematical models for core disruptive accidents in LMFBR systems.

25877 (INIS-mf—2027) **A literature survey for information on failure of LWR fuel rod cladding during LOCA conditions.** Bech, N. (Danish Atomic Energy Commission, Risoe. Research Establishment). Feb 1974. 144p. INIS.

A literature survey for references on fuel rod cladding failures under LOCA conditions in light water reactors is presented. The study covers roughly the period from 1970 to the end of 1973.

25878 (INIS-mf—3032) **Rock siting of nuclear power plants from a reactor safety standpoint. Status report, October 1974.** (Centrala Driftledningen, Vaellingby (Sweden)). Jan 1975. 20p. (CDL-PM—1975). INIS.

The aim of this study is to clarify the advantages and disadvantages of an underground nuclear power plant from a reactor safety point of view, compared to a plant above ground. Principles for the technical design of a rock sited BWR nuclear power plant are presented. Also questions of sabotage and closing down the plant at the end of the operational period are treated.

25879 (KFKI—74-68) **Nuclear accident dosimetry measurements at third IAEA intercomparison, Vinca, Yugoslavia, May 1973.** Palfalvi, J.; Makra, S. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Sep 1974. 27p. INIS.

11 figs.; 17 refs.; 9 tables.

Nuclear accident dosimeters from several countries were compared in Vinca, Yugoslavia at an IAEA meeting. The Hungarian Central Research Institute for Physics team performed measurements for the dosimetry of a heavy water assembly which has an escape spectrum significantly differing from the escape spectra of the fast reactors used in previous intercomparisons or from the light water systems used in the Institute. Another problem investigated was the influence of minor spectral differences on the dose determined by activation measurement and spectrum fitting. The importance of sophisticated spectrum calculations was proved. The Vinca irradiations were used for the calibration of the albedo dosimeters of the Institute, which are currently applied for personal dosimetry.

25880 (KURRI-TR—123, pp 22-27) **Failed fuel detection and nuclear reactor safety.** Kondo, S. 1974. (In Japanese).

From Study meeting on failed-fuel detectors; Kumatori, Osaka, Japan (17 Jul 1973).

In Study meeting on failed-fuel detectors.

The primary role of failed fuel detection as a safety device of nuclear reactor is to monitor whether the release of fission product in the core is within the permissible range and to help operator in deciding as to whether the reactor should be shutdown due to the detected failure. In this comment, this role of FFD is discussed for the case of stationary failure such as pin hole in the clad and of transient failure caused by any local anomaly. Then

necessary characteristics of FFD is obtained by the simple analyses of the concerned fuel failure situations.

25881 (NEDO—10905-2) **High-Pressure Core Spray System Power Supply Unit. Amendment 2.** Chakraborty, S. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Apr 1976. 18p.

Additional data requested by NRC on the power supply unit for the high-pressure core spray system in General Electric BWR's is presented.

25882 (NP—20962) **Analysis of uncertainty in ground motion and structural response due to earthquakes. Research report R69-24.** Vanmarcke, E.H.; Cornell, C.A. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Civil Engineering). Apr 1969. 65p. National Science Foundation, Washington, DC.

Sources of uncertainty in seismic risk analysis are examined.

25883 (ORNL/NUREG/TM—10) **Multirod burst test program. Quarterly progress report, October—December 1975.** Chapman, R.H. (Oak Ridge National Lab., Tenn. (USA)). May 1976. Contract W-7405-eng-26. 65p. Dep. NTIS $4.50.

Internally pressurized unirradiated Zircaloy tubes containing tubular electric heaters (to simulate nuclear fuel pellet heating) will be tested to failure in a low-pressure superheated-steam environment. These assemblies will be heated over a 915-mm (approximately 36-in.) length at a constant rate of 28°C/sec (50°F); differential pressures will range from about 700 to 14,000 kPa (100 to 2000 psi), corresponding to approximate rupture temperatures from 1200 to 700°C (2200 to 1300°F). In addition to measurements of cladding surface temperature and internal pressure during the transient test, data will be obtained on pre- and post-test flow resistance (for the multirod arrays) and on deformation, rupture strain, and channel blockage (as measured by sectioning of tubes and tube bundles). Progress made on design and construction of components and systems, development tests and evaluations, and procurement of long delivery items are summarized. Preliminary results of single-rod tests are presented.

25884 (ORNL/NUREG/TM—14) **Blowdown heat transfer program. Quarterly progress report, January—March 1976.** Thomas, D.G.; Baucum, W.E.; Bohanan, R.E. (Oak Ridge National Lab., Tenn. (USA)). 16 Jun 1976. Contract W-7405-eng-26. 79p. Dep. NTIS $5.00.

Progress is summarized in the areas of two-phase flow instrumentation studies, Forced Convection Test Facility (FCTF) operation, program planning and analysis, Thermal-Hydraulic Test Facility (THTF) operations, Thermal-Hydraulic Test Facility instrumentation, and fuel rod simulator procurement and development.

25885 (SAND—76-0163) **Light water reactor safety research program. Quarterly report, October—December 1975.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1976. Contract AT(29-1)-789. 71p. Dep. NTIS $5.50.

The Molten Core—Concrete Interactions Study was initiated on July 15, 1975, to provide a qualitative, scoping exploration of the phenomena associated with contact between molten core materials and concrete. The experimental elements of this study are divided into four categories: (1) deposition of corium-type melts onto concrete, (2) kinetics and stoichiometry of the thermal decomposition of concrete, (3) response of concrete to high heat fluxes at one surface, and (4) simulation experiments which explore phenomena at the interface between a melt and a decomposing solid. The experimental results are being incorporated in a scaling analysis which will establish scaling parameters for the system and identify key elements of the melt-concrete interaction. No major tests were possible during the quarter because the 90 day curing period for the concrete continued through December. Instead, additional small scale testing, analysis, and other exploratory projects were pursued, and preparations for the major tests were completed. The significant accomplishments of this quarter are summarized.

25886 **Nuclear energy and democracy.** Derian, J.C. *Futuribles;* No. 3, 205-212(Jul 1975). (In French).

An analysis of the nuclear controversy in the US and in France shows the economic consequences of US opponents' action, the economic and social consequences that could result from renunciation to the French nuclear program, and the complexity of technology assessment.

25887 **Out-of-pile safety studies performed for light water reactors.** Courtaud, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Transferts Thermiques). *Bull. Inf. Sci. Tech. (Paris);* No. 209, 23-36(Dec 1975). (In French).

The out-of-pile experimental program performed at the Heat Transfer Laboratory of the CEN-Grenoble in view of constructing the physical models and correlations employed in the computer codes used for describing loss-of-coolant accidents in light water reactors is presented. This program is mainly concerned - for the blowdown phase - with studies of heat transfer in rod bundles performed in the OMEGA loop (4,5MW 170 bars) and of critical flow and flashing in the Moby Dick (10 bars, 360kW) and Canon facilities; -for the core reflooding phase- with the study of heat transfer in rod bundles and rewetting of clad performed on the ERSEC loop (450kW, 6 bars).

25888 **Analyses of rewetting in water reactor emergency core cooling inclusive of heat transfer in the unwetted region.** Chun, M.H. Buffalo; State Univ. of New York (1976). 264p. University Microfilms Order No. 76-17,002.

Thesis (Ph. D.).

One-dimensional analysis of rewetting a vertical hot surface is carried out without neglecting heat transfer in the unwetted region. The physical model consists of an infinitely extended vertical thin slab whose initial surface temperature is higher than the Leidenfrost point. During rewetting, three different regions of constant heat transfer coefficients are assumed: (1) the surface of the wetted region as characterized by a higher constant heat transfer coefficient (h/sub c/), (2) the two regions of unwetted surface which is precooled via a lower constant heat transfer coefficient (h/sub df/) for the fog-film region, and (3) the negligible heat transfer coefficient for the superheated vapor-film region (h/sub ds/). An explicit formula which computes the wet front velocity is obtained for the more general case when the value of h/sub df/ is a finite value. A quantitative analyses of phi and fog length (l), which denotes the fraction of unevaporated water droplets (and vapor) constituting fog-film flow and the distance between the wet and fog front, respectively, are carried out using the most typical bottom-flooding experimental results as reported by Case et al., and PWR-FLECHT report. The results show that phi values fall within the upper and lower bounds derived from theory.

ENERGY STORAGE

MAGNETIC

REFER ALSO TO CITATION(S) 26878

FLYWHEELS

REFER ALSO TO CITATION(S) 26015, 26016

25889 **Multi-ring filament rotor.** Rabenhorst, D.W. (to Johns Hopkins Univ.). US Patent 3,964,341. 22 Jun 1976. Filed date 26 Feb 1975. 18p.

A rotary energy storage device or flywheel structure is provided with a rim portion comprised of multiple rings or windings of filamentary material having high tensile strength and which are bonded or otherwise held together at a predetermined number of localized areas, such as at opposite ends of one or more radial spokes so that major portions of the individual rings or windings may expand with minimum constraints during rotation of the flywheel structure.

25890 **System for energy storage and dc to ac conversion.** Diggs, R.E. US Patent 3,970,917. 20 Jul 1976. Filed date 16 Jul 1975. 8p.

A system is disclosed for storing electrical energy and for converting dc power to ac power. The system includes a very large flywheel which is mounted in an evacuated housing and is driven by a plurality of wheels powered by dc electric motors which receive current from an input power source. An independent plurality of wheels coupled to ac generators selectively engage the rotating flywheel to withdraw energy from rotating mass of the flywheel in the form of alternating current. Control systems are provided for adjusting the radial position of the drive and output wheels in dependence upon the speed of the flywheel. Additional control systems are provided to change the number of driving motors or output generators in contact with the flywheel depending upon the input power available or output power required.

THERMAL

REFER ALSO TO CITATION(S) 25575, 25577, 25578, 25616, 25636, 25638

BATTERIES

REFER ALSO TO CITATION(S) 26501

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 25902

25891 (ANL—76-9) **High-performance batteries for off-peak energy storage and electric-vehicle propulsion. Progress report, July—December 1975.** (Argonne National Lab., Ill. (USA)). Apr 1976. Contract W-31-109-Eng-38. 97p. Dep. NTIS $5.00.

This report describes the research and management efforts of Argonne National Laboratory's program on high-performance lithium/metal sulfide batteries during the period July—December 1975. The batteries are being developed for two applications: off-peak energy storage in electric utility networks and electric-vehicle propulsion. The battery designs for the two applications differ, particularly in cell configuration and electrode design, because of the differing performance requirements. The present cells are vertically oriented, prismatic cells with two negative electrodes of a solid lithium—aluminum alloy and a central positive electrode of iron sulfide (FeS_2 or FeS). The electrolyte is molten LiCl—KCl eutectic, which requires a cell temperature of about 400—450°C. Effort was continued on the development of engineering-scale cells with hot-pressed electrodes assembled in the uncharged state (positive electrode of Li_2S—Fe, negative electrode of Al). Studies of electrodes were directed principally toward developing positive electrodes of FeS_2 and FeS in carbon-bonded structures and toward improving the performance and lowering the cost of negative Li—Al electrodes. Materials studies included work on improved separators and feedthroughs, corrosion tests of materials in the cell environment, and postoperative examinations of cells. Work in the area of cell chemistry included the continuing studies of cell reactions and investigations of advanced cell systems. Battery design work was directed toward the design of a battery for an electric vehicle, development of battery components, and design and construction of battery testing facilities. Efforts were continued on contractual arrangements with industrial firms to develop and fabricate cells, electrodes, and cell components; the first contractor-produced cells were delivered to ANL. 29 figures, 15 tables.

25892 (CONF-760416—2) **Applications and prospect of energy storage batteries.** Yao, N.P. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 4p. Dep. NTIS $3.50.

From IEEE region six conference; Tucson, Arizona, United States of America (USA) (7 Apr 1976).

The major incentive for the U. S. to develop commercial-scale batteries and other efficient storage systems is the potential saving of petroleum and natural gas. Storing the off-peak energy derived from coal and nuclear base generating plants and discharging it during the periods of high demand is the concept contemplated for electric utility application. Wide use of electric vehicles in big cities and urban areas for the improvement of air quality is another incentive. This paper addresses three key areas: the technical and economic requirements of batteries for applications to electric utility and to electric vehicles, the current development status of battery technology in the U. S. and the level of development efforts, and the prospects and the schedule for implementing the advanced battery technology. 1 table. (RWR)

25893 **Lead dioxide—zinc rechargeable-type cell and battery and electrolyte therefor.** Villarreal-Dominguez, E. US Patent 3,964,927. 22 Jun 1976. Filed date 10 Oct 1974. 6p.

A lead dioxide—zinc rechargeable-type cell comprises at least one positive lead dioxide plate and at least one negative amalgamated zinc metal plate spaced from the positive plate and parallel to it. Both plates are permanently submerged in an aqueous acid electrolytee containing soluble zinc salts, a zinc surface-controlling agent, an electrolyte conductivity-correcting agent, and an amalgamating agent to prevent formation of localized cells or electrolytic pairs on the zinc plate during discharge. An electrolyte suitab.e to be used in a lead dioxide—zinc rechargeable-type cell comprises an aqueous acid solution of a zinc salt, aluminum sulfate as the zinc surface-controlling agent, sodium sulfate as the electrolyte conductivity-correcting agent, mercuric sulfate as the amalgamating agent, and sulfuric acid as an aggressive agent which also acts to minimize the "treeing" of the anodic surfaces. More particularly, an electrolyte to be used in a lead dioxide—zinc rechargeable-type cell comprises from 1 to 5 g/l of zinc sulfate, 25 to 75 g/l of sodium sulfate, 25 to 75 g/l of aluminum sulfate, 2 to 8 g/l of mercuric sulfate, and 250 to 500 g/l sulfuric acid, the remainder being water. Preferably, the electrolyte may additionally contain 10 to 30 g/l of a suitable gum such as dextrin to improve the physical structure of the zinc deposited, and 5 to 15 g/l of dibutyl amine as a corrosion inhibitor.

25894 **Battery having deformations in a metal layer.** Oltman, J.E.; Feldhake, R.H. (to ESB Inc.). US Patent 3,964,932. 22 Jun 1976. Filed date 14 Aug 1975. 10p.

A plurality of deformations is provided in a metal layer in a battery to avoid wrinkles in that metal layer. The deformations may be situated in that portion of the metal layer which is part of a peripheral sealing system for the battery and/or in that portion of the metal layer inside the peripheral sealing system. The deformations may be oriented along axes which are (a) substantially concentric with the edges of the peripheral sealing system, (b) substantially perpendicular to the edges of the sealing system, or (c) neither (a) or (b). The metal layer may have a pocket indented therein, the indented pocket being situated inside the peripheral sealing system and over the electrodes of the battery. 17 figures.

25895 **Molten salt electrochemical systems for battery applications.** Mamantov, G.; Marassi, R.; Chambers, J.Q. (to Secretary of the Army). US Patent 3,966,491. 29 Jun 1976. Filed date 13 Feb 1975. 4p.

A molten salt electrochemical system for battery applications is provided comprising aluminum as the anode, positive oxidation states of either iodine or sulfur as the cathode, and a low-melting-point molten mixture of aluminum chloride and alkali chloride disposed between the anode and cathode and in contact with each.

25896 **Sodium sulfur battery or cell with improved ampere-hour capacity.** Ludwig, F.A. (to Ford Motor Co.). US Patent 3,966,492. 29 Jun 1976. Filed date 20 Aug 1975. 12p.

An improved secondary battery or cell comprises the following components: (A) One or more anodic reaction zones contain a molten alkali metal reactant-anode in electrical contact with an external circuit. (B) One or more cathodic reaction zones contain (1) a cathodic reactant which, when the battery or cell is at least partially discharged, is selected from the group consisting of a single-phase composition comprising molten polysulfide salts of the anodic reactant and a two-phase composition comprising molten sulfur and molten sulfur saturated polysulfide salts of the anodic reactant and (2) an electrode of porous conductive material which is at least partially filled with the cathodic reactant. (C) A cation-permeable barrier to mass liquid transfer is interposed between and in contact with the anodic and cathodic reaction zones, the porous conductive material being in electrical contact with both the cation-permeable barrier and an external circuit. The improvement comprises the following: employing a porous conductive material which will wick both sulfur and alkali metal polysulfides and which, in different regions of the cathodic reaction zone, exhibits different degrees of wettability by the alkali metal polysulfides, the material in a region adjacent to the cation-permeable barrier being more readily wetted by the polysulfides than is the material in a region further removed from the barrier such that sulfur will boil near the barrier and condense away from it;disposing the porous conductive material within the cathodic reaction zone such that it forms and encloses one or more channels which extend from the region adjacent the cation-permeable barrier outward into the region of the cathodic reaction zone which is further removed from the barrier; and maintaining the amount of molten cathodic reactant within the cathodic reaction zone such that the channels remain free of the molten reactant and are thus adapted to transport sulfur vapor. 3 figures.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 25893, 25894

25897 **Rechargeable mercury electrode.** Jueng, M. (to Varta Batterie Aktiengesellschaft). US Patent 3,966,493. 29 Jun 1976. Priority date 2 Apr 1969, German, Federal Republic of (F.R. Germany). 12p.

A rechargeable mercury/mercury oxide electrode is described which has a high capacity, especially for primary cells and accumulators, and which has a metal matrix with a non-pyrophoric amalgam. The electrode is capable of repeated charging and discharging cycles during which the mercury is present as mercury oxide and mercury, respectively. The electrode is capable of a flat and constant discharge curve, with an electrical current discharge approaching the theoretical capacity of the electrode. 5 figures, 4 tables.

25898 **Impregnation of electrodes for nickel cadmium batteries.** O'Sullivan, T.D. (to Bell Telephone Labs., Inc.). US Patent 3,966,494. 29 Jun 1976. Filed date 21 Oct 1974. 8p.

A process is described for making nickel—cadmium batteries in which the cadmium electrodes for these batteries are elec-

trolytically impregnated under special conditions and employ a particular electrolytic solution. The electrolytic solution contains not only a soluble form of the cation of the active ingredient for the electrode and nitrate ions, but also certain other ions such as chloride, iodide, and sulfate ions, which increase the rates of impregnation and also increase the electrode loadings. In addition to obtaining more rapid and greater electrode impregnation, the present process improvements facilitate use of a continuous impregnation procedure.3 figures, 3 tables.

25899 Method for the production of lead storage battery electrodes. Eriksson, T. (to Aktiebolaget Tudor). US Patent 3,966,495. 29 Jun 1976. Priority date 1 Nov 1973, Sweden. 6p.

Positive electrodes for lead storage batteries are produced by "forming" the electrodes in an alkaline electrolyte containing an anion which forms a very slightly soluble lead compound. The electrode may also be immersed, prior to forming, in pure water, an aqueous solution of sodium sulfate, and/or sodium hydroxide.

25900 Method for preparing electrodes for an electrochemical storage cell. Gadessaud, R.; Audry, C. (to Compagnie Generale d'Electricite). US Patent 3,967,976. 6 Jul 1976. Priority date 28 Mar 1974, France. 8p.

According to a first embodiment of this invention, the collector part of the electrode is formed by a full plate on which are deposited longitudinal strips of polytetrafluoroethylene before the depositing of the electrochemically active part. In a second embodiment, the collector part is formed by a grid which is coated, before the depositing of the electrochemically active part, with a zinc oxide paste and polytetrafluoroethylene. In this way, one or more spaces are provided between the collector part and the electrochemically active part, the result being that the gases given off by the reaction process may escape easily by following the space(s) and thus avoid any deformation of the electrode. 5 figures.

25901 Resin sheet having porous layered structure useful as electrode separator for electric cells. Honda, S.; Hata, H.; Simura, Y.; Une, S. (to Sekisui Kagaku Kogyo Kabushiki Kaisha). US Patent 3,967,978. 6 Jul 1976. Priority date 30 Mar 1973, Japan. 16p.

A resin sheet having a porous layered structure useful as an electrode separator for electric cells is described. The sheet comprises an olefin resin, a finely divided inorganic substance, and at least one substance selected from the group consisting of a water-swellable thermoplastic resin, a water-insoluble or difficultly water-soluble hydrophilic nonionic surface active agent, and a water-insoluble or difficultly water-soluble hydrophilic anionic surface active agent. The sheet includes fine pores arranged throughout its cross section in a plurality of layers, at least some of them forming open cells. This sheet is prepared by a process comprising fabricating a mixture containing the above components into a sheet, and stretching the sheet in at least one direction. 2 figures.

APPLICATIONS

REFER ALSO TO CITATION(S) 26015, 26033

25902 (CONF-760469—3) **Batteries for utility load leveling.** Nelson, P.A., Yao, N.P. (Argonne National Lab., Ill. (USA)). 1976. 22p. Dep. NTIS $3.50.

From American power conference; Chicago, Illinois, United States of America (USA) (20 Apr 1976).

A critical need for conservation is to reduce the use of dwindling oil and gas resources in electric energy generation. Leveling or peak shaving electric utility loads by means of off-peak energy storage devices would allow an orderly shift to increased utilization of base-load energy, and thereby decrease the use of oil and gas by turbine generators. The concept of energy storage by batteries is particularly attractive for electric utility applications. This paper addresses three key areas: the technical and economic requirements of batteries for applications to electric utilities, the near-term technology for the lead—acid battery and the prospect for its use in utility applications, and the development status and the incentives for developing advanced battery technology. The Battery Energy Storage Test Facility is also briefly discussed; it will provide a test bed for advanced batteries in a utility network. 1 figure, 6 tables. (RWR)

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 25197

SYSTEMS STUDIES AND TOTAL ENERGY

REFER ALSO TO CITATION(S) 25788, 25940, 25944, 25967, 25968, 25976, 25984, 25991

25903 Energy: mathematics and models. Proceedings of a SIMS conference on energy held at Alta, Utah, July 7-11, 1975. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976). 303p. Society for Industrial and Applied Mathematics, 33 S. 17th St., Philadelphia, PA 19103 $16.00.

Sponsored by the SIAM Institute for Mathematics and Society (SIMS).

Conference participants, including mathematicians, energy researchers, academicians, and representatives from industry and government, examined the limits and potential of applying mathematical analysis to the complex problems of energy. The twenty papers presented at this conference are grouped under these headings: 1) Energy Systems Models for Policy Analysis I: Linear Programming Models; 2) Energy Systems Models for Policy Analysis II: Non-Optimization Models; 3) Forecasting: Demand, Supply, and Price; 4) Design of Energy Systems and Alternative Technologies; 5) Power System Planning; and 6) Reactions, which includes comments on other papers and presentations of new mathematical ideas of interest to conference members. Thirteen papers are abstracted separately in EAPA. Two papers were announced in earlier issues of EAPA. (BYB)

25904 PILOT linear programming model for assessing physical impact on the economy of a changing energy picture. Dantzig, G.B.; Parikh, S.C. (Stanford Univ., CA). pp 1-23 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

The research to date on energy systems models at the Institute for Energy Studies and the Systems Optimization Laboratory of Stanford University is reviewed in this paper. A dynamic, linear programming model on a pilot scale is described, which is designed to relate in physical terms technological interactions within and across economic sectors of the U.S., including a detailed energy sector. The model would provide information on what the U.S. could accomplish energy-wise over the next 30 years. This model is intended to be small enough to have the agility for extensive experimentation, but will incorporate recent data of good quality so that it can generate scenarios depicting the economic effect of various energy policies. This paper provides a description of the model; a general mathematical statement of the model; and a review of the current status of the model, its mathematical structure, and possible solution approaches. (12 references) (BYB)

25905 Linear programming and technology assessment. Cherniavsky, E.A. (Brookhaven National Laboratory, Upton, NY). pp 24-35 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

The Brookhaven Energy System Optimization Model, which is described in this paper, is a linear programming model designed as a tool for energy technology and policy assessment. This model has been used to assess the impacts of new technologies on the energy system, and to determine the effects of certain assumptions, or scenarios, in a particular planning year. The explanation of the model includes discussions on supply equations, capacity equations, peaking equations, demand equations, end-use limitation equations, environmental constraints, and the objective function. Applications of the model have included assessments of individual technologies, such as a study on electric energy storage, as well as studies dealing with the competitive aspects of groups of technologies, e.g., an investigation into the strategy of electrification. (BYB)

25906 Project Independence evaluation system integrating model. Wagner, M. (Federal Energy Administration, Washington, DC). pp 36-48 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

The Project Independence Evalaution System (PIES), a forecasting tool for policy analysis used by the Federal Energy Administration, is made up of three major components: a demand model, a collection of supply models, and an integrating model. This paper discusses the integrating model, which uses linear programming approximations of the outputs of the supply and demand

PIES components together with an interative technique to estimate an equilibrium solution. Discussion covers the equilibrating mechanism; the linear program, including demand, supply, transportation and energy conversion process activities; and a mechanism by which the marginal cost pricing assumption associated with an equilibrium solution can be altered to incorporate the effects of regulation (e.g., in studies on pricing of electricity and natural gas). Examples of the types of policy analysis for which PIES has been used are mentioned. (BYB)

25907 Wisconsin regional energy model. Foell, W.K.; Mitchell, J.W.; Pappas, J.L. (Univ. of Wisconsin, Madison). pp 49-69 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

The Wisconsin Regional Energy Model is a computerized dynamic simulation model developed to describe Wisconsin's energy system within a multidimensional framework that encompasses energy demand, conversion, transport, consumption, and environmental impact, taking account of technological and economic considerations. The model provides detailed information on the energy system and its interactions with other sectors in the state. The structure of the model can be applied to other regions of the U.S. This paper presents a summary of the model and its applications, which have included an evaluation of the impact of building codes, energy conservation measures in the industrial and commercial sectors, development planning for the State, natural gas allocation and curtailment impacts, and electrical generation forecasts. (13 references) (BYB)

25908 Structural analysis of energy systems. Roberts, F.S. (Rutgers--The State Univ., New Brunswick, NJ). pp 84-101 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

A series of new geometric methodologies, called structural analysis, is described in this paper. There are two types of methodologies for analyzing complex systems--arithmetic methodologies and geometric methodologies. Arithmetic methodologies work with specific numerical values, make exact time-specific forecasts, and tend to be aimed at optimizing certain parameters. Geometric methodologies deal with shape and structure, require less exact data, can work with variables which are difficult to quantify, and make predictions concerning qualitative trends. Structural analysis begins by defining a structural model through these steps: 1) variables relevant to the problem are identified; 2) binary interactions among pairs of variables are identified (i.e., for each ordered pair of variables, it is determined if one variable augments, inhibits, or has no effect on the other; and 3) where possible, the level of the augmenting or inhibiting effects identified in the second step is quantized. Applications of a particular type of structural analysis, the digraph technique, are presented, including a signed digraph of electric power demand in a given region, a signed digraph of demand in intra-urban commuter transportation; a weighted digraph for the almost-all-automobile transportation systems of San Diego; and a weighted digraph for the San Diego bus system. Mathematical and other problems that need to be solved before structural anlaysis methods can progress are discussed. It is suggested that structural analysis may be the best technique for studying complex systems. (17 references) (BYB)

25909 Reaction paper: on simplifying assumptions in energy models. Marcus-Roberts, H. (Montclair State College, Upper Montclair, NJ). pp 268-272 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

The models described in papers presented at this conference are criticized for making gross assumptions about relationships and complex interactions. Because these assumptions may be oversimplifications or incorrect, the conclusions from the models are difficult to interpret. Several questions are raised: 1) how are submodels connected in a large overall model; 2) how are conclusions of a medium scale linear programming model affected by the assumption that about 60 or 70 variables satisfy only linear constraints with no interactions; 3) what about hidden assumptions, e.g., the assumptions about the lack of interactions or about the types of interactions that may exist; 4) are deterministic models, that predict events and phenomena with absolute certainty, better than stochastic or probabilistic models when dealing with complex interactions; and 5) should modellers use gross (black box) models or parametric models. Because models may often have questionable assumptions and be based on inaccurate data, it is important to subject models to sensitivity and validation analysis. If modellers must continue to use gross, simplifying assumptions, the limitations these assumptions put on the model's conclusions should be clearly stated. (BYB)

25910 Urban utilization of waste energy from thermal-electric power plants. Ieri, A.; Reistad, G.M.; Schmisseur, W.E. (Oregon State Univ., Corvallis). *J. Eng. Power;* **98**: No. 3, 309-319(Jul 1976).

Oak Ridge National Laboratory (ORNL) has made a large-scale study of urban utilization of thermal energy from steam-electric power plants. A system was investigated which bleeds off steam, at various pressures, for supplying the thermal requirements of space heating, air conditioning, and domestic water heating in urban communities located at some distance from the power plant. This paper reports the findings of a study on urban utilization that was part of an integrated system study for utilizing warm water from steam-electric power plants. In the study, the steam bleed-off system studied by ORNL and a heat pump system are considered. Both systems are evaluated for supplying the thermal energy requirements of space heating, air conditioning, and domestic water heating for urban communities ranging in size from 30,000 to 200,000 population. Three site locations which are quite different climatologically are considered; (1) eastern Oregon with severe summer and winter conditions, (2) the Willamette Valley with moderate summer and winter conditions, and (3) coastal Oregon with moderate winters and mild summers.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 25904, 25933, 25937, 25958

25911 (BNL—50500) **Relationship of energy growth to economic growth under alternative energy policies.** Behling, D.J. Jr.; Dullien, R.; Hudson, E. (Brookhaven National Lab., Upton, N.Y. (USA)). Mar 1976. Contract E(30-1)-16. 247p. Dep. NTIS $8.00.

This report is the first of a series of studies that will analyze the economic and social impacts of research, development, and demonstration plans of the Energy Research and Development Administration. Two policy proposals were examined against a Base Case set of economic and energy projections for the years 1985, 1990, and 2000: (1) the introduction of RD and D-initiated energy supply and end-use conversion technologies to expand domestic enegy supply and to improve the efficiency and flexibility of its use; and (2) the imposition of taxes and tariffs on petroleum and natural gas to reduce demand for these primary energy sources. Targets for the amounts of imports of oil and gas were specified by ERDA as follows: 10 percent (or less) of total U.S. energy consumption in 1985; 8 percent (or less) of total U.S. energy consumption in 1990; and 5 percent (or less) of total U.S. energy consumption in 2000. The purpose of the analysis was to first identify the degree to which the introduction of new energy technologies and/or the imposition of energy taxes could reduce oil and gas imports toward the target levels; and second, to estimate the effects of these policies on the economy and the environment. These economic and environmental effects are thus a measure of the costs associated with meeting the import targets. The benefits of these policies, in the form of increased economic and political security were not measured. The analysis was based on an analytic framework which linked detailed mathematical process engineering and economic models to more aggregate econometric models. The four models employed are described.

25912 (PB—239998) **Minicipal and industrial reimbursement for a water resource project in Wyoming's Platte River Basin.** Huff, C.E. (Wyoming Univ., Laramie (USA)). Mar 1974. 147p. NTIS $5.75.

The study consisted of an analysis of current and proposed reimbursement mechanisms pertaining to municipal and coal industry growth resulting from an interbasin water diversion to Wyoming's Platte River Basin. Criteria used in the analysis were: (1) efficiency, (2) equity, (3) revenue raising ability, and (4) administrative feasibility. The impacts and reimbursement flows affecting the business sector, government sector, and household sector were depicted in impact and reinbursement matrixes for Converse County, WY. The conclusions pointed out the need for several changes in, or additions to, the present system of reimbursement mechanisms. (GRA)

25913 Energy resources development in Wyoming's Powder River Basin: an assessment of potential social and economic impacts. Matson, R.A.; Studer, J.B. Laramie, WY; University of Wyoming (1974). 170p. Water Resources Research Institute, University of Wyoming, Laramie, WY 82070.

An assessment is made of the possible socio-economic impacts of development of coal and uranium resources in Wyoming's Powder River Basin. This area, consisting of eight counties in the northeastern part of the State, is generally sparsely populated. However, energy resource development is expected to cause a sharp increase in employment and population within a decade, mainly due to an influx of young, highly-paid workers. Increased demand for labor for energy development will probably drive labor costs up throughout the region. Housing shortages may become the most significant environmental problem. Four scenarios, differing in their projected level of coal development, were used to forecast employment and population. All four scenarios predict significant changes in employment and population prior to 1980. The scenarios differ mainly in the post-1980 growth path. This anticipated employment and population growth will not be spread evenly throughout the eight counties. More research is needed in these areas: 1) the effects of population growth with respect to housing and public facilities; 2) the source of labor; 3) income levels; and 4) settlement patterns. (BYB)

25914 1976 U.S. agricultural outlook. Papers presented at the National Agricultural Outlook Conference sponsored by the U.S. Department of Agriculture, held in Washington, D.C., November 17-20, 1975. Prepared for the Committee on Agriculture and Forestry, United States Senate. Washington, DC; Committee on Agriculture and Forestry (1975). 440p. GPO $3.80.

The National Agricultural Outlook Conference is held annually to provide information on production, prices, input supplies, and demand for products. A second aim of the Conference is to forecast the direction and magnitude of agricultural trends for the next year. This 1976 Conference is of special interest due to the continued uncertainty in the agricultural industry and the turnaround in the trends for commodities from the previous year. The papers are organized under the following topics: 1976 Economic Outlook; Agricultural Outlook; Food--Supplies, Demand, and Consumption; Agricultural Inputs and Productivity; International Women's Year; U.S. Agriculture in the World; Commodity Outlook for Wheat, Rice, Canadian Wheat, Feed, Oilseeds, Fats, Oils, Livestock and Meat, Poultry and Eggs, Dairy, Fruits and Tree Nuts, Vegetables, Timber Products, Tobacco, Cotton, and Sugar; and Family Living. Two papers, 'How Households Use Energy' and 'The Department of Commerce Energy Labeling and Energy Efficiency Programs for Household Appliances,' are abstracted separately. (BYB)

25915 Credibility issue seen crucial to U.S. firms: energy crisis reveals public's skepticism; gives business chance to restore trust. Richardson, E.L. *Commer. Am.;* **1**: No. 14, 11-12(5 Jul 1976).

Secretary Richardson states that the energy problem engulfs a whole complex of interlocking problems—technical, legal, economic, environmental, and human; in a long-, short-, and intermediate-range time span; and both domestic and international in scope. Public support is needed, he feels, for the right policies and programs because cooperation is needed for their success and many involve the expenditure of tax dollars. He points out an opinion survey by the FEA, which reveals that most people do understand the energy demand and supply problem; that there is wasteful use of energy; and that there is a need to conserve. They favor measures—especially in the abstract—that promote energy conservation; but on a practical basis, have fallen back into the carefree energy-consuming binge—largely because of their attitudes of skepticism and cynicism, feeling they had been manipulated or exploited. Mr. Richardson feels that these attitudes are the No. 1 problem; and that until they can be dispelled and the general public made fully aware of the seriousness of the situation, more information, more and better regulations and legislation, and even improved technology will not suffice. He sees this—restoration of credibility—as a great challenge and opportunity for American business; a chance to restore the highest ethical and moral standards in the conduct of business. (MCW)

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 25541, 25921, 25948, 25954, 26434, 26435, 26439, 26440, 26441, 26442, 26443, 26444, 26445, 26524

25916 (PB—241188) **National environmental manpower planning conference held in Phoenix, Arizona, December 8—11, 1974.** (Environmental Career Center, Inc., Washington, D.C. (USA)). Dec 1974. 183p. (CONF-741263—). NTIS.

From National environmental manpower planning conference; Phoenix, Arizona, United States of America (USA) (8 Dec 1974).

The National Environmental Manpower Planning Conference was held in Phoenix, Arizona, on December 8-11, 1974 in an effort to assist State and local environmental agencies in meeting environmental manpower and training needs generated by the delegated responsibilities to carry out environmental programs mandated by Federal Legislation. Planned and conducted by the Office of Education and Manpower Planning, Office of Planning and Management, U.S. Environmental Protection Agency, in cooperation with the Arizona State Department of Health, and Conference provided the participants with an excellent opportunity to share information and take part in meaningful dialogue aimed at acquainting each with available resources and Federal/State activities regarding the development and utilization of an environmental workforce. (auth)

25917 (PB—245833) **Implementation plan review for Virginia as required by the Energy Supply and Environmental Coordination Act.** (Environmental Protection Agency, Research Triangle Park, N.C. (USA)). Feb 1975. 57p. (EPA—450/3-75-016). NTIS $4.50.

In response to Section IV of the Energy Supply and Environmental Coordination Act of 1974, the Environmental Protection Agency reviewed Virginia's State Implementation Plan to determine if control regulations for stationary fuel combustion sources can be revised to conserve scarce fuels without interfering with the attainment and maintenance of the National Ambient Air Quality Standards. These conclusions were reached concerning the State Implementation for Virginia: 1) for total suspended particulates, there are no indications that existing fuel combustion source emission limiting regulations are over-restrictive; and 2) for sulfur dioxide there are indications that emission limits may be relaxed in some air quality control regions without exceeding National Ambient Air Quality Standards. (BYB)

25918 Indiana's industrial effluent monitoring program before and after the NPDES permit program. Stevens, P.L.; Via, S.R. (Indiana State Board of Health, Indianapolis). pp 176-183 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

There have been many problems with the initial phase of the National Pollutant Discharge Elimination System (NPDES) permit program, the drafting and issuance phase but it is logical to assume that there will be many more problems with the second phase of the progrmas--the monitoring and enforcement phase. One of the problems will result from the fact that the NPDES framework has a tendency to prevent the Environmental Protection Agency from making engineering or administrative judgments when enforcement action is needed. As long as EPA encourages public involvement as done currently, the threat exists of public interest groups filing suits for violations of the permits, and it will be difficult for the administering agency to ignore a violation no matter how frivolous or how valid the permittee's violation may be. The agency will be forced to bog itself down in administrative orders that could very well be prevented with the application of sound engineering judgment. (PCS)

25919 Quantitative ecology and impact assessment. Eberhardt, L.L. (Battelle Pacific Northwest Labs., Richland, WA). *J. Environ. Manage.;* **4**: No. 1, 27-70(Jan 1976).

Some of the issues of environmental impact assessment are reviewed from the point of view of quantitative ecology, and on the assumption that evaluations are done on a site by site basis. Two approaches are examined in detail, one being the traditional experimental approach and the other one attempting to predict impacts from data and models. The experimental approach suffers from the fact that there is no true replication. A pseudodesign is proposed, employing pre-operational data on a site and a control area contrasted to post-operational data on both areas, and substituting replication in time for true replicate areas. Even so, the limitations of animal census methods and substantial variability make it doubtful that any but major changes can be detected experimentally. Predictive techniques, employing methods developed primarily for fisheries management, may be preferable to the base line and monitoring concept. However, these methods have not yet been adequately adapted to the present purpose, and some gaps can be foreseen. One is the lack of knowledge about stock-recruitment, when the recruits are at very early life history stages. The population regulation problem is identified as a major issue in impact evaluation. Questions are raised as to the utility of data on productivity and species diversity, as presently used. It is concluded that stock must be taken of what has been done in impact evaluation, and attempt to reach a consensus as to future methodology.

ENERGY RESOURCES

REFER ALSO TO CITATION(S) 25912, 25952

25920 (SAND—76-5155) **Perspective on materials in the energy program.** Claassen, R.S. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 34p. (CONF-760133—1). Dep. NTIS $4.00.

From Distinguished lecture series II; Albuquerque, New Mexico, United States of America (USA) (22 Jan 1976).

This is an introductory paper for a series of presentations treating the general theme "Critical Materials Problems in Energy Production." Energy and materials are closely linked in many ways; e.g., production of materials, which requires their recovery and processing to manufacturing, consumes about 17 percent of all energy used in this country. To fully understand how materials affect our evolving energy program, one needs first to understand the interconnections with other aspects of the situation. Thus, in Section I, some historical perspective reveals what energy consumption has been thus far and what it is likely to be in the future. Section II provides the units and conversion factors most often used in energy discussions. The uses of energy and the forms that energy must take to be consumable are summariezed in Section III. Financial aspects, particularly capitalization problems and fuel expenses, are covered in Section IV. The final section then provides a brief description of the materials problems to be discussed by the other authors in this series. 40 references.

25921 **Resource inventory helps states face common problems.** *Commer. Am.*; **1**: No. 14, 4-6(5 Jul 1976).

The Pacific Northwest's economy is getting a helping hand from hundreds of miles out in space. Remote-sensing satellites and U-2 photographic aircraft closer to earth are helping the Pacific Northwest Regional Commission (PNRC) demonstrate the usability of remote sensing to strengthen the natural resource planning and management capabilities of the region. More than 35 state and local agencies, five major state universities, NASA, and the Department of Interior have joined together under PNRC sponsorship in a project using space-age technology to inventory the area's natural resources. Under the Land Resource Inventory project, two Landsat satellites developed by NASA view the Pacific Northwest electronically every nine days. Each satellite then produces digital images that represent the amount of light being reflected in various wavelengths. Since different types of soil, vegetation, housing, and other objects reflect different amounts of light, these images, when analyzed with the aid of a computer, provide economic information about the Earth's surface. Combined with high-altitude aerial photographs and selective checking at ground level, this method may provide very reliable information for management planning and decision making. In selected areas of each state, the project is exploring possible economic applications of this remote-sensing technique in four disciplines: forestry, agriculture, rangeland, and urban development. The potential for both monetary savings and improved resource management in each of these areas is cited. (MCW)

RESEARCH AND DEVELOPMENT

REFER ALSO TO CITATION(S) 25911, 25951

25922 **Mathematics in energy research.** Lucas, W.F. (Cornell Univ., Ithaca, NY). pp 253-263 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

Comments are made on the potential role of mathematics in energy research and on other papers presented at the Conference. It is concluded that the energy problem has a considerable amount of quantifiable structure. The research to date indicates that a good start has been made in applying mathematics to the energy field. However, mathematics could make much more of a contribution than it has thus far. Several suggestions are made to improve the situation: 1) additional research should be directed toward the more immediate world situation; 2) entirely new mathematical methodologies or ingenious uses of known mathematics need to be developed; 3) additional projects studying the entire world oil market would be useful; 4) studies should be more complete and less selective; 5) researchers should be aware of the many potential pitfalls when working with equilibrium models; 6) additional research is needed into cooperative concepts, such as fairness, sharing, equity, and justice; and 7) more communication, exchange, and cooperation between different research activities would be helpful. (BYB)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 25391, 25466, 25727, 25786, 25787, 25941, 25975, 25987, 26912

25923 (CONF-750720—, pp 153-172) **Nuclear-based energy resources.** Sep 1975.

From Conference on the magnitude and deployment schedule of energy resources; Portland, Oregon, USA (21 Jul 1975).

In Magnitude and deployment schedule of energy resources.

The deployment schedule for fission technology, the breeder reactor program, and fusion technology options are mutually consistent. The present-day fission-based program consists of 55 operating nuclear power plants capable of generating 37 GW of electricity, with another 200 GW of capacity either under construction or on order. The presently estimated uranium-235 reserves are sufficient to fuel all of these plants to the year 2000, as well as the other 600 to 800 nuclear plants that could potentially come on line by that time. While there is no necessity that the U.S. confine itself to domestically mined uranium, this capability may be an extremely important factor in avoiding the political price manipulatings such as those presently taking place in the international oil market. Ultimately, however, the U.S. must introduce the nuclear breeder reactor to take advantage of the fuel potential of uranium-238 and thorium-232. Early introduction can lead to a more advantageous utilization of our nuclear resources. Wide-scale deployment of commercial breeders beginning in 1995 is deemed realistic and highly desirable, but it will require a major implementation program starting today to reach this objective. The most sophisticated and difficult technology, that of fusion, is in a research stage in which the scientists and engineers are still working to solve the fundamental problems of confinement at extremely high temperatures. Subgroup papers are presented on Fission Technology, by Karl P. Cohen; Breeder Reactor Programs, by Leonard J. Koch; and Fusion Technology, by Warren E. Quinn. (MCW)

25924 **Fusion as an energy option.** Steiner, D. *Oak Ridge Natl. Lab. Rev.*; **9**: No. 2, 1-6(Spr 1976).

The environmental issues, alternative fusion fuels, the economic potential, and the time scale of fusion power are assessed. It is common for the advocate of a long-term energy source to claim his source (fission, fusion, solar, etc.) as the ultimate solution to man's energy needs. The author does not believe that such a stance will lead to a rational energy policy. Dr. Steiner encourages a long-term energy policy that has as its goal the development of fission breeders, fusion, and solar energy—not be totally reliant on a single source. He does advocate vigorous funding for fusion, not because it is a guarantee for "clean, limitless, and cheap power," but because it may provide an important energy option for the next century. (MCW)

25925 **Going nuclear. Some implications of the introduction of nuclear energy as the basic primary energy supply of a developed society.** Haefele, W.; Sassin, W. *Rev. Energ.*; **26**: No. 276, 805-825(Sep 1975). (In English, French).

On the basis of nuclear energy as a pimary energy source, the future development potential of secondary energies are considered. These energy forms are coal gasification, process heat for industrial uses and district heating, and mainly hydrogen production which represents 60% of the future secondary energy demands. By using decision tree method, the eventuality of using nuclear energy as unique energy source is examined, and the successive options implied in this approach are analyzed.

25926 **California's Proposition 15: the what and why of its defeat.** *Electr. Perspect.*; No. 3, 22-25(1976).

This analysis of the June 8, 1976 California Nuclear Initiative was prepared by the Pacific Gas and Electric Co. The defeat of Proposition 15 in the California election was successful for several reasons. A record 70 percent of the voters in California went to the polls and 97 percent of those voted on the nuclear issue with the results showing defeat by two-to-one. Apparently, the voters perceived the Nuclear Initiative as being too drastic. The campaign for defeat of the initiative stressed the consequences of closing down existing plants and closing off the nuclear option in California, namely: higher costs, job losses, and less-desirable alternatives. The campaign waged for the Initiative seems to have suffered from weak management and lack of consistent messages. (MCW)

25927 **Status and future directions of fusion power research and development.** Hirsch, R.L. (Energy Research and Development Administration, Washington, DC). *Aware;* No. 70, 10-15(Jul 1976).

From 3. energy technology conference; Washington, DC, USA (29 Mar 1976).

The demonstration of practical fusion power may be achieved by the beginning of the 21st century. Fusion research in the United States presently emphasizes three magnetic confinement techniques and laser-pellet fusion. The tokamak concept appears at present to be the most promising and represents about 65 percent of the effort. The ORMAK experiment at ORNL has demonstrated that confinement improves as the square of the plasma size and has demonstrated plasma heating to 15,000,000°C. The Adiabatic Toroidal Compressor (ATC) at Princeton has demonstrated the concept of heating a tokamak plasma by compression in major and minor radii. The theta-pinch program is carried out almost entirely at LASL, and "ignition" temperatures of 50,000,000°C have been achieved. The Scyllac sector is part of a torus designed to eliminate end-loss of plasma particles. The 2X-IIB at Lawrence Livermore Lab., the principal experiment in the magnetic mirror program, has achieved a temperature of 130,000,000°C. Now ready for testing reactor level plasma conditions is the Princeton Large Torus. The next step after PLT will be a tokamak device capable of burning deuterium and tritium fuel on a regular basis, to be designated Tokamak Fusion Test Reactor and to also be built at Princeton. The Doublet Fusion Reactor Concept, General Atomic Company, will utilize technology developed for the HTGR program. In the laser-fusion concept, experimental conditions have not yet been optimized. The advantages of fusion power are summarized. (MCW)

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 25962, 26912

CONSERVATION

REFER ALSO TO CITATION(S) 25516, 25527, 25578, 25943, 25982, 25983, 26000, 26008, 26359

25928 (CONF-751181—, pp 29p, Paper 1) **Energy for survival.** Clark, W. 1975.

From Conference on solar architecture; Tempe, Arizona, United States of America (USA) (26 Nov 1975).

In Proceedings of the ASC/AIA Forum '75 solar architecture.

The author says the energy crisis is primarily a crisis of use, not of supply. He cites data from the U. S. Department of the Interior that indicates the maintenance of an American each year requires 21,600 lbs of non-metal resources, 1,450 lbs of metal substances, 18,600 lbs of fossil fuels, and almost an ounce of uranium. The human equivalent of this requirement is equal to 300 slaves working 24 hours each day. This energy requirement is also putting a strain on the environment, and the energy equivalent of this restraint is calculated. A discussion on conserving energy requires an examination of the flow of energy in society. Energy-conserving technologies in industry, transportation, homes, and buildings are reviewed. Total energy systems, fuel cells, heat pumps, and solar heat for buildings are innovative technologies for buildings. Other technologies that can reduce energy use in buildings include the use of electric wind generators to supply electricity; water and sewage recycling systems to reduce use and supply compost; auxiliary wood fuel systems; and community integrated-alternative energy systems. It is concluded that potential savings through the increased use of solar energy, heat pumps, climatic siting of new buildings, maximum retrofitting of buildings and homes with energy-conserving insulation should result in a 60 percent reduction in energy use within 15 years. The impact of substituting large-scale renewable energy sources such as wind, solar, and hydroelectric is summarized, followed by discussions on energy conservation and the food system, transforming urban solid wastes to fertilizer and fuel, awareness and public acceptance of energy conservation. 41 references. (MCW)

25929 (FEA/D—76/325) **Total energy management. A practical handbook on energy conservation and management.** (National Electrical Manufacturers Association, New York (USA)). Mar 1976. 57p. NTIS $4.50.

This handbook provides a practical approach for building owners and managers to implement energy conservation procedures and to use energy wisely. It allows businessmen to make knowledgeable judgments on where and how to conserve energy while maintaining optimum business activity. Total Energy Management (TEM) is an energy conservation approach based on the premise that to effect energy savings in buildings one must make the building's systems as efficient as possible. In this way, they will consume the smallest amount of energy to perform the functions required. By considering all elements of a building's system, one can recognize a great many areas where savings can be achieved. Therefore, TEM provides owners and managers the flexibility required to conserve energy and cut costs while meeting the needs of the building's users at the same time. (54 references) (GRA)

25930 (FEA/D—76/341) **ECASTAR. Energy conservation: an assessment of systems, technologies, and requirements.** Vachon, R.I.; Lueg, R.E.; Humphries, W.R.; O'Brien, J.F. (Auburn Univ., Ala. (USA)). Sep 1975. 779p. NTIS.

ECASTAR presents a methodology for a systems approach display and assessment of the potential for energy conservation actions and the impacts of those actions. The U.S. economy is divided into four sectors--energy industry, industry, residential/commercial, and transportation. Each sector is assessed with respect to energy conservation actions and impacts. The four sectors are combined and three strategies for energy conservation actions for the combined sectors are assessed. The three strategies (national energy conservation, electrification, and diversification) represent energy conservation actions for the near term (now to 1985), the mid term (1985 to 2000), and the far term (2000 and beyond). A feature of the assessment methodology is the identification of targets of opportunity for large net energy savings and the application of technology to achieve these savings. In addition, citizen's actions for energy conservation are discussed. (280 references) (GRA)

25931 (PB—251665) **Economic impact study of the appliance efficiency program.** Woroniak, A.; Murphy, J.J. (Infodyne Systems Corp., Potomac, Md. (USA)). 30 Jun 1975. 281p. (FEA/D—76/077). NTIS $9.25.

The objective of this report is to analyze the economic impact of the technical improvements that would have to be incorporated into major household appliances to make 1980 models of such appliances provide the same level of performance as 1972 models, but require on the average 20% less energy to operate. One consequence foreseen from such an improvement in energy efficiency was the saving by 1985 of over one half million barrels of oil per day. The appliances covered by the efficiency program are: room air conditioners; electric and gas water heaters; refrigerators and refrigerator/freezers; freezers; electric and gas ranges; electric and gas dryers; washers; dishwashers; and black and white and color televisions. Specific energy efficiency goals for 1980 are listed for each type of appliance. (40 references) (from Executive Summary)

25932 **Energy conservation by consumers. Session I.** pp 20-86 of In Purdue energy conference of 1975. Lafayette, IN; Purdue University (1975).

From Purdue energy conference; West Lafayette, Indiana, United States of America (USA) (19 Jun 1975).

See CONF-7506128—.

Four papers on energy conservation in industry, in transportation, in agriculture, and in Evansville, Indiana were presented in this session. Robert S. Spencer feels that an effective industrial energy conservation program must be a proper combination of engineering, education, and encouragement. Three industries alone account for more than 50 percent of the total U.S. industrial energy consumption: primary metals, chemicals, and petroleum refining. U.S. industry consumes 22 percent of all primary energy used. Raymond E. Goodson reviewed the evolution of transportation and its energy usage: autos, 54 percent; trucks, 22 percent; air, 10 percent; pipelines, 5 percent; water, 4 percent; transit less than 1 percent; and rail, 4 percent. The primary goal of the national transportation system now is energy conservation, followed by improving the environment, increasing safety, reducing congestion, increasing miles per dollar, and providing for the non-driver. Otto Doering, in discussing energy conservation in agriculture, pointed out that the total food and fiber system consumes about 12 to 14 percent of the total energy consumed in the U.S.; Robert Pickett then discussed the coordination of all the inputs of agriculture to maximize acreage, growing seasons, and cost; Robert Peart then discussed the following: fossil fuels in agriculture, with their shortage and advancing prices demanding the practice of energy conservation; energy demand in corn production and crop rotations involving wheat and soybeans; and some experiences of solar drying of grain. Major Russel Lloyd of Evansville, Indiana, cited energy shortages experienced by the city in 1975 and discussed measures taken to survive the crisis. (MCW)

25933 **Influences on energy conservation. Session II.** pp 87-139 of In Purdue energy conference of 1975. Lafayette, IN; Purdue University (1975).

From Purdue energy conference; West Lafayette, Indiana, United States of America (USA) (19 Jun 1975).

See CONF-7506128—.

Thomas Kibler discussed Pride, the governor's conservation program, set up by the governor in 1975 to encourage individual communities to organize local committees to implement activities and then, importantly, recognize the achievements upon reaching the desired conservation efforts. Jay Wiley, in a paper, The Influence of Higher Prices, cited data regarding energy consumption in the U. S. during the time of advancing prices. Energy consumption has decreased since the Arab oil embargo, but it changed at the same rate as the economy; this change in usage can be attributed almost entirely to non-price factors; further, in the short run, given the absence of alternatives available to consumers, gasoline and petroleum demand are not price elastic. In a final paper, Legislative and Regulatory Needs, Larry J. Wallace explained the responsibilities of the regulatory agencies; the existing laws are deemed inadequate and the author says they need to be recoded before action is taken on any major regulation changes. (MCW)

25934 How households use energy. Newman, D.K.; Day, D. (Project on Race and Social Policy, Washington, DC). pp 354-368 of In 1976 U.S. agricultural outlook. Washington, DC; Committee on Agriculture and Forestry (1975).

From National Agricultural Outlook Conference; Washington, DC (17 Nov 1975).

Energy policy aimed at lowering consumption should take into account that all households are not alike in their energy habits, and measures to restrict overconsumption of the rich can lead to hardship for the poor. Two national sample surveys--one of households and the other of electric and natural gas utilities--were used to match the amount and cost of energy consumed with the characteristics of the households. Trends indicate a shift to single family dwellings with fewer persons per household and an increase in energy consumption with higher income. Since 1973 there has been an increase in oil use and a decrease in gas use for heating, and a substantial decrease in central air conditioning. The largest gap in income-related consumption is in the use of the automobile. Recommendations include a program of loans and subsidies for low- and middle-income housing, elimination of exclusionary zoning, flat rate structure with peak-load pricing for electricity, and coordinated energy policies designed to raise housing standards and increase efficiency of construction, appliances, and automobiles. Taxes based on car weights are urged. In results of a 1973 questionaire, most households at all incomes preferred increasing energy supplies and using less energy to higher prices and lower population. (DCK)

25935 Department of Commerce energy labeling and energy efficiency programs for household appliances. McGuire, B.J. Jr. (National Bureau of Standards, Washington, DC). pp 369-377 of In 1976 U.S. agricultural outlook. Washington, DC; Committee on Agriculture and Forestry (1975).

From National Agricultural Outlook Conference; Washington, DC (17 Nov 1975).

Legislation mandating programs to reduce residential energy consumption has been passed in both houses of Congress and would preempt diverse state and local programs. Regulations of the Energy Labeling Program cover energy data to advise consumers of product efficiency, with specifications given for rating room air conditioners, refrigerators, freezers, and water heaters. It is expected that specifications for all appliances will be available by the end of 1976. The Commerce Energy Efficiency Program would involve only the manufacturers in a voluntary goal of 20% reduction of energy usage in appliances by 1980. (DCK)

25936 Transportation energy considerations. French, A. (Federal Highway Administration, Washington, DC). *Transp. Eng. J.*; **102**: No. TE1, 27-45(Feb 1976).

Oil is used at the rate of nearly 20,000,000 barrels per day, and a nearly equivalent amount of energy is consumed that is produced from other fuels or by other means. About half of the oil is used for transportation propulsion with 18 percent of all energy, or 40 percent of petroleum, used for highway propulsion. Thus, the greatest petroleum shortage is associated with this mode of travel. This paper examines ways of cutting highway fuel consumption in half while accommodating 1985 travel demand. The following fuel consumption matters are discussed: eliminating trips; walking and bicycling; improved vehicle miles per gallon; trip consolidation; carpooling; truck shipments with full loads; improved highway facilities; using carpool-bus lanes; school bus riders walk or bicycle. Alternative fuels, alternate modes, and financing procedures are also examined. The conservation measures examined could reduce 1985 highway fuel usage by 40 to 60 percent below 1973 usage and accommodate a 30 percent increase in travel demand. (MCW)

25937 States may need aid to obtain aid for energy-conservation programs. *Energy Res. Rep.*; **2**: No. 7, 1-3(Jul 1976).

The $50 million in aid for states' energy conservation, authorized by Congress in the Energy Policy and Conservation Act of 1975 (PL94-163), would more than fill the gap left by shrinkage of other Federal programs. But much of the $50 million will be difficult to get, even for states like Pennsylvania which has an energetic conservation program. To qualify for aid, governors must fight difficult political battles on state and local levels. The priorities that Congress imposes as funding criteria are mandatory lighting-efficiency standards for public buildings; programs to promote carpooling and public transport; legalization of right turns at red lights; establishment of energy efficiency as a governing consideration in the procurement procedures of states and their political subdivisions; and mandatory thermal-efficiency standards and insulation requirements for new and renovated buildings. Guidelines for meeting those criteria were recently promulgated by the Federal Energy Administration, but FEA has not yet published critical data projections and measurement methodologies. (MCW)

25938 Second time around: Federal Government emphasizes recycling. *Commer. Am.*; **1**: No. 17, 7-8(16 Aug 1976).

The U.S. government has drawn up specific programs for conserving energy through recycling. Since the government itself purchases billions of dollars' worth of supplies and materials, its impact on procuring recycled products will be great. In addition to conserving natural resources, increased use of recycled materials will reduce the volume of wastes that would require disposal charges. The National Commission on Materials Policy has estimated that about 2 percent of the total U.S. energy demand could be saved by recycling of available steel, aluminum, and paper. The Environmental Protection Agency reports that recycling could provide possibly 8 percent of aluminum, 7 percent of iron, 20 percent of tin, and 14 percent of paper consumed annually. New specifications have had to be adopted for some purchasing regulations in some government agencies. Specific Federal programs include: the revision of 86 specifications for paper-based products by GSA; the Department of Defense reviewing its existing policies concerning procurement specifications to include recycled materials; EPA issuing voluntary guidelines and procedures for Federal agencies in procuring products that contain recycled material; and the passage of an Energy Policy and Conservation Act of 1975 requiring the National Bureau of Standards and the Federal Trade Commission to develop and issue test procedures for the recycling of used oil. (MCW)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 25343, 25928, 25947, 25964, 25969, 25978, 26598

25939 (BNL—50483) **Sourcebook for energy assessment.** Beller, M. (ed.). (Brookhaven National Lab., Upton, N.Y. (USA)). Dec 1975. Contract E(30-1)-16. 211p. Dep. NTIS $7.75.

An analytical approach is presented that is broadly applicable to the assessment of energy technologies and policies. Using the Reference Energy System approach, it permits the examination of the economic, environmental, and resource implications resulting from the substitution of one fuel or technology for another. Included as tools for such analyses are the necessary data and methodology, as well as a set of Reference Energy Systems covering the 1972-2020 period to serve as baselines for the perturbation analyses of interest. 46 tables, 25 figures, 71 references.

25940 (BNWL-SA—5677) **Structure of a simulation model for energy-related regional assessment.** Fraley, D.W.; Swift, W.H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1976. Contract E(45-1)-1830. 23p. (CONF-760435—4). Dep. NTIS $3.50.

From 7. annual conference on modeling and simulation; Pittsburgh, Pennsylvania, United States of America (USA) (26 Apr 1976).

The structure of a dynamic simulation model designed to analyze the effects of potential future energy policies and actions as a multistate, regional level is described. The simulation structure includes the interacting effects of energy development, energy- and macro-economics, and demography on land use, water resources, air quality, ecosystems, and society.

25941 (EPRI-SR—34) **Nuclear power, coal, and energy conservation, with a note on the costs of a nuclear moratorium.** Auer, P.L.; Manne, A.S.; Yu, O.S. (Rand Corp., Santa Monica, Calif. (USA)). Mar 1976. 32p. NTIS.

A programming model is used to explore some of the options by which the United States may realistically move away from its present heavy dependence on oil and gas to a more diversified energy economy, based on nuclear power and/or coal. The model

incorporates both own- and cross-price elasticities. In this way it allows for price-induced interfuel substitution and price-induced energy conservation. Among the supply options considered are: the direct combustion of coal to generate electricity; the conversion of coal to synthetic fuels; the limited petroleum, natural gas, and shale oil resources; nuclear energy from light water reactors and, later, from fast breeder reactors; hydrogen via electrolysis; and such distant future technical options as central station solar power and fusion (aggregated and described only as 'advanced technology'). Each of these energy sources is discussed in terms of its own costs and the probable date of its commercial introduction. ... Under a plausible set of assumptions (the base case), this report finds that the present value of the benefits from both the fast breeder and coal-based synthetic fuels well exceeds their anticipated research and development costs. In an optimum mix, the combined benefits would be nearly $50 billion (in 1975 dollars) discounted at 10% annually over the 75-year span of our study, and $450 billion at a 5% annual discount rate. Under the same conditions, it is also found that if a nuclear moratorium prohibiting the construction of additional plants throughout the country were to come into effect, the direct cost to the United States economy would be approximately $300 billion at a 10% discount rate and $2500 billion at a 5% rate. (20 references) (auth, abstract modified)

25942 (NSF-RA-N—74-224) **Energy supply and demand in Texas for the period 1950—1973. Project S/D-1, final report.** Grubb, H.H.; Holloway, M. (Texas Governor's Energy Advisory Council, Austin (USA)). Aug 1974. 121p. National Science Foundation, Washington, DC.

The energy production and consumption data show a pattern of increased reliance on crude oil and natural gas as primary energy sources. Early production of coal diminished as natural gas became readily available. Hydropower has been developed at several multipurpose dam sites, but is less than one percent of the total Texas electric power capacity. Power plants have been fired primarily with natural gas, but recent developments have caused the substitution of fuel oil, and plans for new capacity include both nuclear and coal fired units. The trends in consumption of energy show several important factors in the economics of energy. Residential use of electricity has grown rapidly and was accompanied by large increases in per capita home heating and air conditioning and electrical appliances, and by a declining real price of electricity. Texas consumers also greatly increased their per capita use of gasoline during the 1950-1973 period with increases in the per capita ownership of automobiles and near constant real prices for gasoline. Both trends (electricity and gasoline use per capita) grew at a faster rate in Texas than for the U.S. The concentration of petroleum refining and chemical manufacturing industries in Texas has made these industries and the State's economy relatively more dependent upon oil and gas. In the face of increasing Texas consumption of energy at the final consumer level and increased concentration of petroleum and chemical manufacturing in Texas, drilling activity and estimated reserves have declined steadily since the mid-1950's. With recent price increases in oil and gas the trend in drilling activity has turned up again but estimates of reserves continued to decline during 1972 and 1973.

25943 Proceedings of the Purdue energy conference of 1975 held in West Lafayette, Indiana, June 19—20, 1975. Lafayette, IN; Purdue University (1975). 271p. (CONF-7506128—). Energy Engineering Center, Purdue Univ., W. Lafayette, IN 47906.

From Purdue energy conference; West Lafayette, Indiana, United States of America (USA) (19 Jun 1975).

Emphasis was placed on problems associated with the "supply of energy" and the "hard choices" which were gradually being forced upon the people of Indiana and upon the U.S. as a whole. A separate abstract was prepared for each of the five main sessions of the conference: Energy Conservation by Consumers; Influences on Energy Conservation; Utilization of Indiana Coal; Nuclear and Coal-Fired Plants; and Energy Policies for Indiana and the Midwest. Also included in the proceedings, but not abstracted, is the testimony by H. R. Linden, President, Institute of Gas Technology, at the Public Seminar, Energy Policy and Resources Development, President's Energy Resource Council, at Department of State, Washington, D.C., Dec. 10, 1974 on energy policy and resource development. (MCW)

25944 Regional model of interfuel substitution. Nissen, D.; Knapp, D. (Federal Energy Administration, Washington, DC). pp 121-132 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

Work on the Federal Energy Administration's demand model since the publication of the 'Project Independence Report' in November 1974 is described in this paper. Development of the model has concentrated on improving the representation of energy demand and fuel substitution in the Household/Commercial and Industrial Sectors. A sample of computed elasticities derived from the model for a representative region and scenario are presented in tabular form. The demand model is tested by determining the response of its equilibrium prices for given quantity shifts, keeping other quantities fixed. The models for the transportation demand sector and raw materials demand sector have not been changed since the Project Independence Report. (BYB)

25945 Overview of energy supply and demand. Waterman, W.W. (Inst. of Gas Tech., Chicago). pp 1-20 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

Available data on present and future energy sources are reviewed. This includes the very important reserves of depletable resources, the projected life spans of such resources, and the contributions that can be expected from nondepletable sources of energy. (JSR)

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 25367, 25906, 25911, 25915, 25917, 25918, 25926, 25933, 25934, 25935, 25940, 25954, 25961, 25963, 25966, 25972, 25989, 26518

25946 (PB—246025) **Energy: the states' response. Energy legislation, January to July, 1975. Volume II.** (National Conference of State Legislatures, Washington, D.C. (USA). Special Task Force on Energy). Aug 1975. 606p. (FEA/E—75/577). NTIS $16.25.

Volume I was announced in EAPA 2(7), abstract No. 1112.

This volume of 'Energy: The States' Response' contains copies of all energy-related legislation passed by the 50 State Legislatures during their 1975 sessions. The actual period covered is January through mid-July 1975. The two volumes of this publication contain 204 bills, totalling 1107 pages and is a compilation of legislative achievement, and vetoed and unsigned bills. Legislation is organized by category. Categories in this volume include resource development/facility siting, resource development/revenue, resource development/renewable resources, resource development/financial incentive, resource development/mineral extraction regulation, management, emergency powers/responses, energy/environment, and miscellaneous. (GRA)

25947 (UCRL—78153) **Changing energy perspectives.** Werth, G.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1976. Contract W-7405-eng-48. 13p. (CONF-760342—2). Dep. NTIS $3.50.

From Symposium on alternate fuel resources; Santa Maria, California, United States of America (USA) (25 Mar 1976).

Several new developments call for a reassessment of the U.S. energy independence strategy: (1) conservation programs have not been effectively implemented; (2) industry is not building synthetic-fuel production plants; and (3) a projected world-wide expansion of oil production may actually lead to price reductions in the 1980's followed by price increases in the 1990's. The Stanford Research Institute energy market model is used to evaluate these new developments. It indicates that acceleration of research and development on synthetic fuels and on increasing the efficiency of energy use may lead to reductions of over $100 billion in the total annual U.S. energy bill in the year 2000 and to a reduction of $30 billion in the total annual energy import bill. Since transportation is the most inefficient sector in terms of energy use, and more and more Americans seem to prefer suburban living, increasing the efficiency of the automobile is crucial.

25948 Energy policies for Indiana and the Midwest. Session V. pp 249-259 of In Purdue energy conference of 1975. Lafayette, IN; Purdue University (1975).

From Purdue energy conference; West Lafayette, Indiana, United States of America (USA) (19 Jun 1975).

See CONF-7506128—.

This session was devoted mostly to an address by Mr. Bill Watt, Executive Assistant to the Governor of Indiana. Mr. Watt feels that Indiana has performed well in view of the lack of a national energy policy during the energy crisis. A review of the efforts by Indiana and other midwestern states indicates many states have implemented successful conservation and fuel allocation programs, have stimulated research and development, have dispensed public information and education on energy issues, and have issued

procedures concerning environmental impacts. Mr. Watt feels that a regional grouping of states can, through exchanging talent and information, do a better job of implementing the programs listed for the states. Additionally, there are regional issues such as offshore drilling for the coastal states, energy production in the Western states and the concern for their water resources, or concern of the states in the Great Lakes' region about their water resources. He also feels that a comprehensive energy plan at the Federal level will be very slow to materialize, if indeed it ever does; the present administration has made some progress, but no tidy blueprint is emerging. (MCW)

25949 Boston Energy Office progress report: September 1974 to December 1975. Tyson, M.G.; Carson, B. Boston; Boston Energy Office (1976). 26p. Boston Energy Office, 18 Tremont St., Boston, MA 02108.

In September 1974 the Boston Energy Office, conceived, developed, and staffed by college students, began operation. As a joint project between the Mayor's Energy and Utilities Task Force and the New England Consortium on Environmental Protection, it is a viable and valuable resource to the City of Boston. Working out of the offices of the Boston Consumers' Council with academic supervision from Massachussetts Institute of Technology faculty, the Office depends completely on students with a variety of backgrounds from the many universities in the Boston and New England area. The Office provides initiative and applies expertise and manpower to innovative projects in addressing energy issues that affect Boston. Involving to date 26 students working over 7000 man hours, the Boston Energy Office has demonstrated the potential to save 10% of the City's $15 million energy budget as well as providing unique services to the Boston community at a total cost of only $8000 in student stipends. ... Projects completed include an in-depth energy conservation analysis in three Boston public schools including one with an experimental solar heating installation, a detailed inventory and monitoring system of the City's own energy consumption and costs, a review of energy use statements contained in Environmental Impact Statements, a solar feasibility study for New England, and assistance to City agencies. A few of the current projects include an educational program in schools, a Home Energy Conservation Program (HECP) which provides energy conservation information directly to homeowners, and a detailed study of energy policy issues affecting the City. (auth, abstract modified)

25950 National policy for energy independence: questions and answers. *Energy (Stamford, Conn.)*; **1**: No. 3, 4-8(1976).

Exclusive interview with Frank Zarb, Administrator of FEA, at Americans for Energy Independence National Summit Conference, April 9, 1976, Reston, Virginia.

Mr. Zarb answers some hard questions including the following: what legislation he thought would pass in 1976; how FEA can expedite construction of coal and nuclear plants; what stand ERDA had taken on nuclear waste disposal; California oil prices; how much oil is lost to Federal regulations; why he supported the 1975 energy bill; why the Administration has not promoted mandatory conservation; the cost of strip-mined coal had the Congressional Act not been vetoed; the prospects of revising automobile emission standards; in case of nuclear accident, what is the emergency plan; what is FEA's position on ERDA's plan to raise the tails assay on its enrichment contracts; restraints on foreign policy by Congress; and will Congress expedite the transmission of Alaskan natural gas to the lower U.S. (MCW)

25951 Who is who: ERDA, FEA; you need the program to tell the players. *Energy (Stamford, Conn.)*; **1**: No. 3, 14-17(1976).

Congress is debating a total reorganization of the administration's energy structure. Senator Abraham Ribicoff has authored a bill (S. 3339) that combines all of the functions under a new cabinet-level Department of Energy and Natural Resources. There is much confusion about the functions of the Federal Energy Administration (FEA) and the Energy Research and Development Administration (ERDA), both created in the Energy Reorganization Act of 1974. Theoretically, ERDA develops new technologies and FEA promotes them; in practice, however, there seems to be considerable overlap and lack of coordination. A "Who to See for What" chart—for each agency—is included here in an attempt to clear the picture somewhat. (MCW)

25952 Richardson, new chairman, brings a new look to the Energy Council. *Energy Res. Rep.*; **2**: No. 7, 9-11(Jul 1976).

As new chairman of the administration's Energy Resources Council, Elliot L. Richardson has become a major figure in United States policy making. This is borne out in an interview with Richard G. Darman, assistant for policy to the new Secretary of Commerce, and with Robert E. Shepherd, director of energy programs in the department, which was conducted Apr. 29 and updated June 3, 1976. Mr. Darman was asked to comment on expected changes under Elliot Richardson. Other queries involved staff members, who selects them, and who plans the agenda. Mr. Shepherd was questioned about industrial energy conservation, what department is responsible for that program, the number of companies participating in conservation programs, and the results of industrial participation in conservation. (MCW)

FOSSIL FUELS

REFER ALSO TO CITATION(S) 25987

COAL

REFER ALSO TO CITATION(S) 25912, 25913, 25941

25953 (CONF-750720—, pp 125-152) **Coal-based energy resources.** Sep 1975.

From Conference on the magnitude and deployment schedule of energy resources; Portland, Oregon, USA (21 Jul 1975).

In Magnitude and deployment schedule of energy resources.

Coal consumption annually in the U.S. is 14 quads, 9 of these for generation of electricity. By 1985 the consumption of coal is slated to increase by nearly a factor of 2 and by the year 2000 by nearly a factor of 3 to 39 quads. This number is for direct combustion only and does not include coal for gas and liquids. Total proven coal reserves are of the order of five thousand four hundred quads—ample to supply energy and chemical needs well into the fusion age. Technical improvements in combustion include: (1) front-end cleanup of the coal—or post-combustion removal of objectional components; (2) innovations in the use of coal by industry, such as district heating; and (3) innovations in power generating techniques such as fluidized-bed combustion and combined cycle/gas turbine/steam turbine systems. An introductory paper to the subgroup papers was given by George H. Hill, Electric Power Research Inst. Subgroup papers are Direct Combustion of Coal, by Thomas A. Henrie; Gasification and Liquefaction, by Erich H. Reichl; and Mining and Transportation of Coal, by Richard A. Schmidt. A Review of Coal-based Energy Resources was presented by Rex T. Ellington. (MCW)

25954 (GS-C—731) **Guide to state programs for the reclamation of surface mined areas.** Imhoff, E.A.; Friz, T.O.; LaFevers, J.R. (Geological Survey, Washington, D.C. (USA)). 1976. 38p. Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, VA 22202 Free.

During 1975 inquiries of agencies in each State and review of State statutes and related administrative codes revealed that 38 States have established programs requiring the reclamation of surface mined lands. Results of analyses of those programs and ancillary data are presented in: (1) a table (matrix) which has been designed for the notation and elaboration of information pertaining to the mined-area reclamation programs of the 50 States; (2) a primer on surface mining activities and related reclamation practices and problems; and (3) a listing of types of non-Federal governmental controls applicable to reclamation. Interpretations of the status and content of State programs suggest that although a common thread runs through State statutory language, administrative requirements vary from State to State in order to meet different natural, economic, social, and political considerations. A general trend is seen in State programs toward the requiring of an integration of land-use planning and mine planning, with increased local governmental involvement. (13 references) (auth)

25955 Utilization of Indiana coal. Session III. pp 140-223 of In Purdue energy conference of 1975. Lafayette, IN; Purdue University (1975).

From Purdue energy conference; West Lafayette, Indiana, United States of America (USA) (19 Jun 1975).

See CONF-7506128—.

Five papers were presented at this session: Indiana's Energy Heritage, by Richard L. Powell; Road Blocks to Increased Coal Production, by George Land; Solving the Air Pollution Problems, by R. B. Engdahl; Measuring Actual Air Pollution Levels in Indiana, by Robert Jacko; and Replacing Natural Gas and Oil with Coal, by J. R. Bowden. Briefly, these presentations included, in order, the following: (1) history of energy resource development in Indiana and an evaluation of future fossil-fuel resources; (2) roadblocks of environmental constraints, financial problems, transportation needs, mining equipment shortages, labor supply, and the moratorium on leasing of Federal coal; (3) a review of research and demonstration units in service to solve air pollution problems; (4) a research project being performed at Purdue to determine present ambient air quality in the vicinity of a selected number of

coal-fired power stations in Indiana; to determine to what degree these power stations are contributing to the total atmospheric ground level burden of SO_x and suspended particulates under varying meteorological conditions; utilization of the data bank to validate theoretical dispersion models; and a description of the sampling methodology; and (5) an examination of the timing, the method, and the amount of replacement of oil and gas with coal; after reviewing the facts, the author says now is the time to replace natural gas and oil with coal, shale oil, nuclear power, or any other energy source. (MCW)

25956 Land reclamation requirements and their estimated effects on the coal industry. Goldstein, M. (International Monetary Fund, Washington, DC); Smith, R.S. *J. Environ. Econ. Manage.;* **2**: No. 2, 135-149(Dec 1975).

This paper develops a model of the bituminous coal industry that is then used to simulate the price, output, and employment effects of land reclamation requirements in strip mining (other things equal). The main conclusion is that a requirement to return strip-mined land to its approximate original contour and vegetative cover would have only slight effects on either sector of the industry. It is estimated that such a requirement, had it been imposed in 1971, would have decreased strip-mining employment and output by 2.3 percent, while inducing an increase in underground employment more than sufficient to offset these job losses.

25957 Coal resource classification system of the U.S. Bureau of Mines and U.S. Geological Survey. *U. S., Geol. Surv., Bull.;* **1450-B**: B1-B7(1976).

In order to use mineral resource terms with precision and common understanding and to compare resource data effectively, a joint U.S. Bureau of Mines and U.S. Geological Survey work group developed a standardized definitive, broadly applicable classification system to derive uniform, coordinated resource estimates, The principles of the system are given in Chapter A of this series (Bulletin 1450-A). This Bulletin describes the coal resource classification system: a concept by which coal beds are classified in terms of their degree of geologic identification and economic and technologic feasibility of recovery. General definitions of coal resource categories follow a Glossary. (MCW)

25958 Coal gasification: is it needed and can it be financed. Flack, E. *Public Util. Fortn.;* **97**: No. 8, 28-31(8 Apr 1976).

Natural gas is now in short supply, and the Alaskan North Slope gas is not expected to be available to markets in the Lower 48 states until the early 1980s. The only other major sources of new gas supplies available to the nation are: (1) liquefied natural gas; (2) imported liquid petroleum products to be used as feedstocks for synthetic natural gas (SNG) plants; and (3) SNG from coal gasification. Government actions are limiting the development of these potential new gas supply sources. Efforts to date to develop the coal gasification industry are summarized. The major obstacle to the construction of large-scale commercial plants is that private industry cannot obtain financing through the conventional sale of equity and debt securities. The capital needed is greater than the worth of the company sponsoring the development. The different types of financial assistance available are listed. The author then cites historical examples when Federal loan guarantees were used, and he urgently recommends that Congress authorize "Federal loan guaranties to get the first two or three coal gas projects under way." (MCW)

PETROLEUM

REFER ALSO TO CITATION(S) 25311, 25343, 25344, 25973

25959 (CONF-750720—, pp 87-124) **Petroleum-based energy resources.** Sep 1975.

From Conference on the magnitude and deployment schedule of energy resources; Portland, Oregon, USA (21 Jul 1975).

In Magnitude and deployment schedule of energy resources.

It appears that neither shale oil nor tar sands can be counted on for substantial quantities of oil to fill the gap between U.S. oil production and demand between now and 1985. Early development of tar and shale oil do provide strategic leverage in dealing with overseas sources of oil in the 1980's and 1990's and ultimately such sources of hydrocarbons will be needed as conventional sources are depleted. Substantial reserves of U.S. oil and gas still remain to be found but prompt governmental action will be needed to do away with price controls so that sufficient risk capital can be made available for the search and development of the various fuels. In addition to oil and gas price decontrol, it is imperative that Federal offshore and Arctic acreage be opened for exploration and development because large oil and gas potentials lie in these areas. The subgroup papers are: Petroleum Resources, by J.N. Garrett; Shale Oil, by Sandra Blackstone; Tar Sands, by Peter J. Benn; and Natural Gas Resources, by Les W. Bierbaum. A Review of Petroleum Energy Resources was presented by Richard L. Jodry. (MCW)

25960 (PB—246393) **End-uses of petroleum products in the U.S.: 1965 to 1975. Volume I. Sources, methods, and results. Volume II. Tabulations of results.** O'Farrell, M.; Roig, R.W.; Mudry, R.N. (International Research and Technology Corp., Washington, D.C. (USA)). 20 Oct 1975. 251p. (PB—246394; FEA/B—75/656; FEA/B—75/657). NTIS Volume I, $5.00, Volume II, $6.75.

This report is a study of the end-uses of four petroleum products: distillate oil, residual oil, aviation jet fuel, and ethane plus propane (combined) in terms of fractional shares of use. The study employs a multilevel structure of detail comprising major categories of end-use, regional uses, and detailed categories of end-use, in that order. Factors taken into consideration in discussing end-use include identification by year, petroleum product, major category of end-use, regional area of use, and detailed category of end-use. These volumes provide an analysis of each fuel considered by discussing sources, calculations and adjustments, and results. Other topics included in this report are space heating use, manufacturing industry use, electric energy generation use, and transportation use. Data sources for the work included mineral industry surveys, census data, privately compiled data, an International Research and Technology Corp. study of the industrial chemical industry, and data gleaned from EPS's National Emissions Data System file. (GRA)

25961 (PB—248381) **Analysis of the feasibility of separating exploration from production of oil and gas on the Outer Continental Shelf.** (Office of Technology Assessment (U.S. Congress), Washington, D.C.). May 1975. 301p. NTIS $9.75.

Present leasing regulations for the Outer Continental Shelf (OCS) are examined, and several alternative procedures, which would allow exploration to be completed before leasing, are evaluated to determine the advantages, disadvantages, and uncertainties of each. The alternatives include three levels of exploration effort (limited, intermediate, and full) by either government or private industry with particular emphasis on these OCS areas: Mid-Atlantic (Baltimore Canyon); Gulf of Alaska, and Southern California. It seems feasible to separate exploration from production for most areas identified in a limited or intermediate exploration program. In order to ensure rapid development of OCS resources, it is suggested that a pilot project in one area be performed concurrent with conventional leasing in other areas. The cost of a limited exploration program is estimated to be between $0.6 billion and $1.6 billion. It is noted that increasing the level of exploration control by inexperienced Government management also increases the uncertainty of success. In addition to separating exploration and production processes, there are many other modifications to conventional leasing which should be examined. The Appendixes include descriptions of OCS leasing and environmental protection activities of the Interior Dept.; provisions of proposed OCS bills; and an analysis of selected exploration costs. Attachments contain selected texts and analysis of current and proposed OCS policies, and a National Ocean Policy Study staff analysis. (BYB)

25962 (PB—248739) **Risk and cost analysis of transporting and storing Gulf of Alaska Outer Continental Shelf oil.** (Booz-Allen Applied Research, Inc., Bethesda, Md. (USA)). 7 Jan 1975. 96p. NTIS $3.50.

The objectives of this study were to measure the risk of oil spills and estimate the costs associated with alternative transport and intermediate storage systems from Outer Continental Shelf (OCS) oil fields to United States west coast terminals and refineries. This was accomplished through a review of past oil spill statistics and analyses, and application of the data to the specific conditions of Gulf of Alaska OCS. To assist in specifying these conditions, a series of strictly hypothetical scenarios were established. Representative production sites were selected without the benefit of dependable estimates of specific reserve locations. (GRA)

25963 United States and international oil. A report for the Federal Energy Administration on U.S. firms and Government policy. Krueger, R.B. New York; Praeger Publishers (1975). 768p. Praeger Publishers, 111 Fourth Ave., New York, NY 10003 $8.50.

Prepared as a FEA report 'An Evaluation of the Options of the U.S. Government in its Relationship to U.S. Firms in International Petroleum Affairs'.

The issue treated in this study concerns the introduction of the U.S. Government into international activities of the U.S. petroleum companies to make sure that National interests are protected. Policy options for providing a role for the Federal Government in international affairs of the petroleum industry are

analyzed. This study examines the historical, legal, political, and economic aspects of the present international system of petroleum supply and determines the possible effects of alternate supply systems. These future policy options are investigated: 1) removal or modification of Federally-created incentives and disincentives to international petroleum production; 2) regulation of oil companies as public utilities; 3) establishment of a National system to limit petroleum imports; 4) regulation of all significant international supply arrangements; 5) creation of a petroleum corporation, completely or partially owned by the Federal Government, to engage in international activities; 6) coordination of international supply arrangements through an industry-wide association of consumer country companies; 7) bilateral arrangements between the U.S. and producer governments; 8) establishment of an international organization to coordinate national petroleum policy with other importing countries; and 9) establishment of multilateral negotiations between producing and consuming countries. It is concluded that there is a need for the Federal Government to assume some role in the petroleum industry's international dealings. This new Government role will probably draw on several of the options examined in this study. (BYB)

25964 **Probabilistic modeling of oil and gas discovery.** Barouch, E.; Kaufman, G.M. (Massachusetts Institute of Technology, Cambridge). pp 133-152 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

The high degree of variability in oil and gas reserve forecasts for the U.S. points out the need for an analytical approach to this estimation problem, in which: 1) the form of the output is useful for policy analysis; 2) the degree of uncertainty of estimates and model parameters can be computed; 3) the model is scientifically credible; and 4) expert judgement can be incorporated as personal (subjective) probabilities. This paper describes part of a probabilistic discovery process model which was developed from assumptions about specific geological, technological, and economic characteristics of the process of exploration in a petroleum basin. There are four major components to this model: 1) a sub-model of pool sizes discovered in order of discovery in a geologically homogeneous population of pools; 2) a sub-model of wildcat drilling successes and failures; 3) a sub-model of the economics of a single exploratory venture; and 4) a sub-model of the 'capital market' for exploratory ventures. Concentrating on the first sub-model, this presentation discusses the basic assumptions from which the sub-model was built, explains the mathematical properties of the sub-model, and covers methods for statistical testing of the basic assumptions. The study uses analysis of data, probability, Monte Carlo simulation, and asymptotic analysis. (BYB)

NATURAL GAS

REFER ALSO TO CITATION(S) 25371, 25375, 25377, 25959, 25961, 25964, 25969

25965 (NP—21009) **Gas reserve estimation of offshore producible shut-in leases in the Gulf of Mexico.** (National Academy of Sciences - National Research Council, Washington, D.C. (USA). Board on Mineral Resources). May 1976. 180p. TIC.

A representative sample of 33 shut-in producible leases on the Outer Continental Shelf were studied to evaluate the estimating techniques and procedures and the gas reserve estimates of the Federal Power Commission (FPC). FPC estimates ran two or three times higher than estimates of two independent consulting firms. Differences in estimates were attributed to interpretation of geological data. The National Research Council panel performing the evaluation concluded that the FPC used standard engineering techniques and procedures, but that the practice of a single-figure estimate instead of a range of estimates could be misleading. The panel recommended using 'high' and 'low' estimate figures. A study was made of misleading terminology which may have contributed to confusion and error in making estimates. The panel recommended using terms like 'reserve,' 'paying quantities,' and 'producible' only in their generally accepted sense. (DCK)

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 25959

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 25257, 25525, 25526, 25527, 25528, 25529, 25530, 25531, 25532, 25533, 25534, 25535, 25536, 25537, 25554, 25555, 25556, 25557

ELECTRIC POWER

REFER ALSO TO CITATION(S) 25910

25966 (PB—241323) **Power shortage contingency program for the Pacific Northwest. Legislative, regulatory, and institutional aspects. Completion report.** Jourolmon, L. (Kell, Alterman, Runstein, and Thomas, Portland, Oreg. (USA)). 1975. 402p. NTIS $10.50.

The report evaluates current principles that should be applied when use of electricity must be rationed either because of critical levels of streamflow or because of slippage of generator schedules, or both. The legal structure controlling the marketing of power throughout the Columbia Basin is examined. (GRA)

25967 (PB—247304) **Electric utilities and equipment manufacturers: factors in acceptance of advanced energy conversion technology.** Smith, D.W.; Korn, D.H. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Sep 1975. 110p. NTIS $5.50.

U.S. electric utility requirements for central station generating equipment and the supplying industry are discussed for the purpose of describing the climate underlying possible commercial acceptance of advanced energy conversion technology. This report also covers institutional factors which might tend to encourage or discourage acceptance. The study contains several short case studies of patterns of acceptance and has business profiles of the major supplier firms. (20 references) (GRA)

25968 **Integrated set of power system planning models.** Peschon, J.; Jamoulle, E. (Systems Control, Inc., Palo Alto, CA). pp 197-215 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society of Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

The steps involved in planning the expansion of an electric power system are listed, and mathematical models useful in analyzing these steps are discussed. The synthesis of results obtained from such models should be made by the planning engineer. Most electric utilities use some of these models routinely (e.g., the load flow simulation). However, several have been recently developed and are not yet used widely. Overview descriptions of some of these newer models are presented, including probabilistic costing production, flow models for network analysis, network security analysis by a direct probability method, and a model for distribution system analysis. Because the majority of these models are simple with respect to computational and data requirements, they are ideal for an interactive implementation. (BYB)

25969 **Utility's forecasting model: the ideal and the real.** Michaelson, W.G. (Public Service Electric and Gas Company, Trenton, NJ). pp 216-227 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

For energy utilities, accurate forecasting is becoming increasingly important, because: 1) lead time for equipment installation is increasing; 2) costs of capital are rising; and 3) the future of U.S. primary energy supply is uncertain. This paper suggests that the results of several forecasting methods or models should be used in making a forecast. The use of these types of models is mentioned: class of business model; rate schedule model; total energy model; a geographic model; an electrical area model; an appliance model; a survey model; and a local model derived from a National model. The forecasting methodology should be such that the forecast is rational, responsible, consistent, explainable, believable, and susceptible to checking and analysis of deviations when actual results are available. (BYB)

25970 **Staff report on electric utility communications and control systems operating or planned as reported April 1, 1975, by the Regional Electric Reliability Councils under docket R-362, order 383-3, (appendix A-1, item 7).** Washington, DC; Federal Power Commission (1976). 24p.

The interconnection of power systems, brought about by the economies and greater reliability of combined operations, has necessitated reliable communication both within and between

power networks. This report surveys those communications systems and is based on information contained in the nine Regional Reliability Council Reports, filed with the FPC April 1. The more frequently utilized communication methods between control centers and major generating plants, substations and switching stations are: dedicated dispatch telephone circuits, independent or interpool leased teletypewriter networks, microwaves, radios, powerline carriers, and overhead insulated static wires. Approximately 98 percent of the major utilities have at least two independent communication systems. Communication channels between area control centers and regional coordination centers are principally teletype and local or long-distance telephone circuits, many of which are separate from Private Branch Exchange (PBX) equipment. About 70 percent of the reporting utilities have independent back-up for the primary channels. (MCW)

25971 Learning to love rate reform. Morgan, M. *Electr. Light Power (Boston)*; **54**: No. 2, 29-30(23 Feb 1976).

An EPRI/EEI research project is starting a study on peak-load pricing (PLP) and how it enables electric utilities to manage their demand. In relation to PLP, metering, price elasticity, and customer acceptance will be studied. The ten topics of the study are described in an additional note. Federal lawmakers are proposing an "Electric Utility Regulatory Reform Act," which would make PLP mandatory, but the utilities are hoping the law is not passed until the EPRI/EEI study is completed, hopefully by September 1976. According to a report by the National Association of Regulatory Utility Commissioners, the proposed legislation would also prohibit declining block rates, abolish promotional advertising by utilities, abolish the fuel adjustment clause, and require lifetime rates until PLP is fully instituted. The EPRI/EEI is not associated with the Federal government except that some task force members work for the government. The study shows that utilities are concerned that they do the correct thing. (MCW)

25972 Energy: by government or free enterprise; which will it be. Tuthill, S.J. (Dept. of Commerce, Washington, DC). *Electr. App.*; **28**: No. 12, 18-20(Apr 1976).

Extracted from an address before the International Energy Engineering Congress.

Two ways out of the energy situation are evaluated: (1) we can go the traditional route through economically motivated adjustments to our national energy habits; or (2) we can go the government product-management route that first appeared in the form of mandatory allocation and Federal price control. The author feels the first path could be followed with the least disruption to our social structure, if President Ford's energy program is enacted that involves (1) getting government out of allocation and price control activities so that both conservation and more production of domestic oil, gas, uranium, and coal are stimulated; (2) taxing windfall profits, and establishing an energy rebate system to ameliorate social and economic inequities, and (3) funding research and development programs to effect a speedy shift of energy dependence from foreign oil and rapidly depleting supplies of natural gas to domestic coal and nuclear sources in the near term and the nondepletable energy resource in the longer term. He feels the second path is a dangerous route toward greater and greater Federal management of productivity of labor, industrial, and commercial systems. A long step into a centralist/Federalist approach was taken when mandatory allocation and price controls were implemented. It was erected under the threat of foreign manipulation of our energy supplies and our domestic economy. In time of emergency, temporary departure from traditional modes of operation can be expected. The danger faced now, under pressure from Congress, is the thorough institutionalization of these emergency measures. Electricity will be in the center of whatever path this nation chooses to follow, and the reasons for this are discussed. (MCW)

25973 Oil as a generating fuel is not an option. Rosenberg, W.G. (Federal Energy Administration, Washington, DC). *Public Util. Fortn.*; **98**: No. 2, 17-20(15 Jul 1976).

For electrical generation, oil is seen as a backstop in case of forecasting errors. Most members of the industry believe that nuclear and coal capacity must be added, but assume that oil-fueled turbines would make up for shortages. However, the consensus among observers of the electric industry is that oil as a generating fuel is not a future option, and this view is the basis for this discussion of policies pertaining to utilities' capital requirements and rates. Three national power objectives are discussed: (1) utility construction of oil-fired generating plants, except for peaking plants, is bad economics as well as contrary to public policy; (2) the alternative to oil must be use of both coal and nuclear; and (3) through the Energy Supply and Environmental Coordination Act of 1974, Congress has given FEA many of the regulatory tools it needs to make sure that cost-effective utility economics and good policy are reflected in actual utility practice. There have been more cutbacks in nuclear plant construction plans than in coal. The author says "a possible scenario is developing which neither consumers nor the Federal government can ignore: one in which, by reason of a combination of the failure or inability of utilities to plan for, and thus be able to provide, adequate coal and nuclear capacity, and the failure of consumers to defend their right to lower cost coal and nuclear electric power, utilities may wish to increase their use of oil as a generating fuel." It is the goal of the FEA to make it possible for both regulators and electric utility managers to justify decisions that achieve the optimum long-run benefit, according to Mr. Rosenberg. (MCW)

25974 Electric peak-load pricing: a Wisconsin framework. Malko, J.R.; Stipanuk, D. (Wisconsin Public Service Commission, Green Bay). *Public Util. Fortn.*; **98**: No. 2, 33-36(15 Jul 1976).

In an important Madison Gas and Electric Company case, environmentalist intervention transformed an ordinary request for an increase in rate levels into a study of problems relating to rate design. The findings in Madison Gas have had a significant impact on actual and proposed pricing policies of major electric utilities in Wisconsin. After the Madison Gas case in 1974, the Wisconsin Public Service Commission directed the major private electric utilities in Wisconsin to perform research studies related to peak-load (time-of-use) pricing. The object of these research efforts were to assess the possibility of placing peak-load cost burdens on the appropriate electric customers, to measure price elasticity of demand for various electric customer classes, and to provide information on alternative load management approaches (in lieu of pricing) to control peak usage. The authors review the progress made to date by five major electric utilities in compliance with the Commission's order. (MCW)

ELECTRIC POWER GENERATION

25975 Nuclear and coal-fired plants. Session IV. pp 224-248 of In Purdue energy conference of 1975. Lafayette, IN; Purdue University (1975).

From Purdue energy conference; West Lafayette, Indiana, United States of America (USA) (19 Jun 1975).

See CONF-7506128—.

After some introductory remarks concerning the possibility of electricity shortages in 1980 and 1985 (using the data of Phillip Ross, Westinghouse), Dr. Phillip N. Powers, Purdue Energy Engineering Center, then introduced Dr. A. David Rossin of Commonwealth Edison Co., who addressed the subject, "Experience with—and Prospects for—Nuclear and Coal-Fired Power Plants." Dr. Rossin, in reviewing a utility's decision-making process for future generating capacity, points out that they consider (1) the need for new plants, then (2) the environmental impact of each type of plant and its fuel cycle. With demand increasing, old plants having to be replaced, and with the necessity to reduce power plant use of the critical fuels oil and gas, this means new coal-fired and nuclear capacity is essential. He feels that solar energy is the only alternative energy source to coal and uranium that could make any contribution to energy supplies in this century. The frustrating experiences of Commonwealth Edison in its recent attempts to purchase low-sulfur coal are reviewed. The uncertainty of nuclear power lies in the future of fuel reprocessing and plutonium recycle and the public's understanding of the safety of nuclear power. But, Dr. Rossin concludes, coal and uranium, with the help of solar energy and conservation, can meet the challenge to eliminate the energy problem. (MCW)

25976 Application of geometric programming to energy-related design problems. Ecker, J.G.; Wiebking, R.D. (Rensselaer Polytechnic Institute, Troy, NY). pp 153-175 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

A major objective of this paper was to show that Geometric Programming is a useful tool for the mathematical analysis of certain energy-related problems. Basic concepts in Geometric Programming are detailed. The use of Geometric Programming as a nonlinear optimization technique is illustrated by applying it to the design of a condensing system for steam electric plants with natural draft cooling towers. The model developed in this paper includes the turbine low pressure sections, associated surface condensers, and the natural draft dry-type cooling towers as one integrated system. A very useful aspect of the Geometric Programming model is its facility for sensitivity analysis. By using the duality theory for Geometric Programming, the optimal cost can be written as a function of the various system parameters. (22 references) (BYB)

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

25977 **Perspective on 765,000-volt transmission.** *Electr. Perspect.*; No. 3, 12-17(1976).

The 765-kV transmission lines operate over 4,000 miles in the U.S. and Canada. Growth in transmission line voltages provides the nation with more reliable, reasonably priced electricity with the least environmental impact. A 765-kV line requires $^1/_{15}$ of the land area per kilowatt of carrying capacity and the construction cost per kilowatt for a 765-kV line is about $^1/_{10}$ the cost of a 138-kV line. The transmission capability provided by EHV reinforces interchanges between companies and systems, thereby assuring greater reliability. It can enable some companies to operate with less reserve generating capacity. The net effect has been to conserve land, fuel, and money. Research and investigations continue on the safety, biological, and environmental effects of these transmission lines. Under consideration are ultra-high voltages, undergrounding, superconducting cables, cryogenics, and high-voltage dc transmission. (MCW)

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 25914, 25920, 25931, 25934, 25935, 25960, 26007, 26008, 26033, 26598

25978 (CONF-760648—1) **Residential energy use alternatives to the year 2000.** Hirst, E. (Oak Ridge National Lab., Tenn. (USA)). 1976. 16p. Dep. NTIS $3.50.

From National science foundation workshop on long-run energy demands; McLean, Virginia, United States of America (USA) (9 Jun 1976).

This paper describes a comprehensive engineering-economic computer model used to simulate energy use in the residential sector from 1970 to 2000. The purpose of the model is to provide an analytical tool with which to evaluate a variety of conservation policies, technologies, and strategies for their impacts on residential energy use and fuel expenditures over time. The baseline forecast developed here shows total fuel use growing from 17.6 GGJ (10^9 joules) in 1975 to 26.4 GGJ in 2000, with an average annual growth rate of 1.7 percent. The percentage of household fuel provided by electricity grows from 44 percent in 1975 to 56 percent in 2000. The percentages provided by all other fuels decline over time. Alternative high and low forecasts show a range in annual fuel use growth from 1975 to 2000 of 2.1 percent to 0.3 percent.

25979 (COO—2791-1) **Energy use for building construction. Preliminary progress report for period March 1, 1976—May 15, 1976.** Hannon, B.M.; Stein, R.G.; Segal, B.; Serber, D. (Illinois Univ., Urbana (USA)). May 1976. Contract E(11-1)-2791. 48p. Dep. NTIS $4.00.

The building construction industry, as broken down by the Bureau of Economic Analysis, U.S. Department of Commerce, was integrated into the Energy Input/Output Model developed at the Center for Advanced Computation, University of Illinois. The resulting expanded model was used to determine energy intensities of various (49) building construction (new and maintenance) sectors and of the overall building construction industry, for year 1967. The latter figure was computed at about 70,000 Btu/$, i.e., the construction industry on the average required about 70,000 Btu of direct and indirect energy per dollar of output produced. The most energy intensive sector was New Construction of Petroleum Pipelines (about 150,000 Btu/$), while the least intensive was Maintenance Construction for Electric Utilities (about 25,000 Btu/$). Also developed were total energy (direct and indirect) requirements to final demand for the building construction industry, for 1967. The overall industry required about 6000 trillion Btu, or about nine percent of the total U.S. energy requirement. New Highway Construction required the most energy to final demand (about 1000 trillion Btu, or 16 percent of the total construction industry requirement), while Maintenance Construction Residential required the least (about 9 trillion Btu, or 0.1 percent of the total industry requirement.

25980 (NSF/RA/N—76-084) **Organic and conventional crop production in the corn belt: a comparison of economic performance and energy use for selected farms.** Lockeretz, W.; Klepper, R.; Commoner, B.; Gertler, M.; Fast, S.; O'Leary, D. (Washington Univ., St. Louis, Mo. (USA). Center for the Biology of Natural Systems). Jun 1976. 46p. (CBNS-AE—7). NTIS.

A two year study is described of fourteen pairs of crop-livestock farms in the Corn Belt, in which one member of each pair used only organic fertilization methods and no pesticides, while the other used conventional fertilizers and pesticides. Data are presented on the yields, production costs, and energy consumption for crop production in 1974 and 1975. The organic group had an overall production level an average of 10% below that of the conventional group in terms of market value of output per acre of cropland. Their operating costs were also lower, so that returns to crop production were equal for the two groups. The conventional group was 2.3 times more energy intensive, primarily because of the energy needed to produce conventional fertilizers. The organic group required 12% more labor per unit of market value of crops produced. Whereas the input and removal of P and K were in balance on the conventionally managed cropland, the organic farmers were drawing somewhat on pre-existing reservoirs of these nutrients. (auth)

25981 (PB—234320) **Para-transit: neglected options for urban mobility.** Kirby, R.F.; Bhatt, K.U.; Kemp, M.A.; McGillivray, R.G.; Wohl, M. (Urban Inst., Washington, D.C. (USA)). Jun 1974. 443p. (UMTA-CA—06-0045-74-2). NTIS $11.75.

Increasing concern over pollution, congestion, and fuel consumption accompanying the use of the private auto in urban areas, together with greater emphasis on needs of those without access to autos, has led to major efforts to upgrade scheduled bus and rapid rail transit service in the U.S. cities. Other forms of transportation which are available to the public and use the streets and highways of urban areas, referred to as 'para-transit,' are now under consideration as transportation alternatives. This study was designed to review the experience to date with para-transit services, to access their potential for servicing urban transportation demand, and to design an R, D and D program as needed to identify and demonstrate innovations in the provisions of para-transit services which would be beneficial. Services studied were grouped into 3 categories: (1) 'hire and drive'—daily car rentals and forms of short-term car rentals that have been proposed including Minicar and Public Automobile System; (2) 'hail or phone'—taxi, dial-a-ride, jitney and related services; and (3) pre-arranged ride-sharing—forms of car pool, van pool, and subscription bus services. Four major applications of para-transit services are identified. Chapters include comparative study of para-transit modes, innovations in para-transit regulations, and case studies. A para-transit bibliography is furnished. Tables and figures complement the text. A summary of this report is 'Para-Transit: A Summary A essment of Experience and Potential.' (GRA)

25982 (PB—241764) **Voice of the transportation consumer. A report to the Secretary of Transportation on nationwide consumer public hearings conducted by the Office of Consumer Affairs, 1971—1974. Executive summary. Final report.** (Department of Transportation, Washington, D.C. (USA). Office of Consumer Affairs). Apr 1975. 116p. (DOT/TES/OCA—75/1). NTIS $5.25.

The Executive Summary includes the background and objectives of the 54 nationwide transportation consumer public hearings held 1971—1974, an overview of the findings, and a summary of transportation concerns identified at the hearings. Subject areas include: balanced transportation; transportation planning; transportation funding; citizen participation in transportation planning; elderly and handicapped; energy; environment; rural transportation; technology; automobile; aviation; bicycles; bus; highways; motorcycles; pedestrians; rail; rapid transit; trucks; and water transportation. (GRA)

25983 (PB—241765) **Voice of the transportation consumer. A report to the Secretary of Transportation on nationwide consumer public hearings conducted by the Office of Consumer Affairs, 1971—1974. Final report.** (Department of Transportation, Washington, D.C. (USA). Office of Consumer Affairs). Apr 1975. 665p. (DOT/TES/OCA—75/2). NTIS $15.25.

The report includes an analysis of transportation concerns expressed by participants at 54 nationwide public hearings held from 1971—1974. Also included is a tabulation of responses to 1,280, 29-part questionnaires returned by hearing attendees. Subject areas include: balanced transportation; transportation planning; transportation funding; citizen participation in transportation planning; elderly and handicapped; energy; environment; rural transportation; technology; automobile; aviation; bicycles; bus; highways; motorcycles; pedestrians; rail; rapid transit; trucks; water transportation. (GRA)

25984 (PB—248118) **Analysis of BART's energy consumption for interim system operations.** Cohn, S.G.; Ellis, R.H. (Peat, Marwick, Mitchell and Co., Bulringame, Calif. (USA)). Jun 1975. 29p. NTIS $3.50.

The Bay Area Rapid Transit (BART) System is the first areawide rail rapid transit system to be built in the United States in 50 years. This system includes 71 miles of track, 34 stations, and such technological advancements as a regenerative braking system plus light, all aluminum cars designed for high acceleration and maximum speeds of 80 miles per hour. This study investigates the historical energy consumption of the BART System, estimates

BART's energy consumption for ultimate design service levels (approximately twice the present level), and compares BART's energy consumption to that of other rail rapid transit systems and alternate modes. (13 references) (GRA)

25985 (PB—248953) **Fuel consumption of tractor-trailer trucks as affected by speed limit and payload weight.** Broderick, A.J. (Department of Transportation, Cambridge, Mass. (USA). Transportation Systems Center). Nov 1975. 34p. (DOT-TSC-OST—75-3). NTIS $4.00.

The effect of speed limit and payload weight on fuel consumption was determined in tests of tractor-trailer rigs. Two virtually identical vehicles were used, one loaded with a 28,000 lb payload and the other carrying 42,000 lbs; each was driven over two different sets of terrain on the Massachusetts Turnpike at simulated speed limits of 50, 55, and 60 mph. Onboard observers recorded data on tank-measured fuel consumption, trip average speed, etc. An analysis of the data led to the following conclusions: (1) increased fuel consumption results from higher speed limits in the range of 50 to 60 mph; (2) terrain is an important factor in determining the effect of speed limit on fuel consumption; and (3) a payload increase from 28,000 lbs to 42,000 lbs is carried at no detectable increase in fuel consumption for the 'hilly' route, and less than a 7% increase in fuel consumption for the route including a crossing of the Berkshire Mountains. (Summary)

25986 **1974 national transportation report: current performance and future prospects.** Washington, DC; Department of Transportation (1975). 720p. GPO $7.50, Stock No. 050-000-00105-9.

The U.S. transportation system is assessed, and options for improving transportation performance are detailed. Information includes plans and priorities for transportation for each state as received from the Governors in cooperation with local officials, and data and analyses on National transportation problems and issues. The report is divided into four parts: 1) Introduction and National Overview; 2) Urban Transportation Developments; 3) Intercity and Rural Transportation Development; and 4) National Issues Affecting Plans and Programs. An appendix, 'Profiles of Public Transportation Plans and Programs,' presents a detailed analysis of the public transportation information on the 52 largest urban areas in the U.S. It seems probable that during the next 15 years, transportation activity, especially passenger transportation, will experience a lower rate of growth than in the past. The rate of energy consumption per unit of transportation activity is also likely to decrease. The States' plans for transportation as contained in this report were developed prior to realization of the fuel supply problem. Many of the long-range plans call for large amounts of public investment in transportation. Opportunities for reducing investment requirements are demonstrated through more intensive use of present capacity while allowing for growth with some improvement in service. (BYB)

UNCONVENTIONAL SOURCES AND POWER GENERATION

25987 (CONF-750720—) **Magnitude and deployment schedule of energy resources. Proceedings of a conference held on July 21—23, 1975, in Portland, Oregon.** Loveland, W.D.; Spinrad, B.I.; Wang, C.H. (eds.). (Oregon State Univ., Corvallis (USA). Dept. of Botany). Sep 1975. 282p. Dep. NTIS $9.25.

From Conference on the magnitude and deployment schedule of energy resources; Portland, Oregon, USA (21 Jul 1975).

The conference had as its major purpose the development of best possible estimates of the magnitude of energy resources in the United States and of the time table when these resources might reasonably be expected to be available for use. The conference was planned because of concern about the lack of information, and the misinformation, available to the general public and to those who make policy decisions regarding energy. Conferees selected for their knowledge of energy resources prepared position papers on the magnitude and availability of five broad types of energy resources: solar, geothermal, coal-based, petroleum-based, and nuclear-based energy. Individual papers were prepared in advance of the conference and consolidated into group position papers in discussion sessions held one day prior to the public conference. On the first day of public meetings, background position papers based on different aspects of each type of energy resource were presented. On the second day, summary position papers were presented by group coordinators and commented on critically by reviewers. The last half-day was devoted to a panel discussion of the position papers followed by a question and answer period during which conference attendees had an opportunity to address questions to the panel. A separate abstract was prepared for each "Group Position Paper" but not for the "Subgroup Position Papers," which also are included. (LMT)

SOLAR

REFER ALSO TO CITATION(S) 25533, 25534, 25544, 25553, 25554, 25555, 25556, 25559, 25572, 25573, 25574, 25575, 25576, 25577, 25578, 25579, 25580, 25581, 25617

25988 (CONF-750720—, pp 9-58) **Solar energy resources.** Sep 1975.

From Conference on the magnitude and deployment schedule of energy resources; Portland, Oregon, USA (21 Jul 1975).

In Magnitude and deployment schedule of energy resources.

ERDA responded to Congressional solar legislation by developing a detailed program described in a "Definition Report, the National Solar Energy Research, Development and Demonstration Program" (ERDA 49) on eight different applications of solar energy. Contributions of new energy sources of wind, photovoltaic, thermal-electric, and ocean thermal gradient are given in addition to hydroelectric expansion for 1985 to 2000. Applications of solar heating and cooling, agricultural and industrial applications, solar electric capacity, wind energy, photovoltaic systems, ocean thermal systems, and fuels from biomass are briefly discussed. Solar energy implications for the long term are summarized with specific implications indicated for the Northwest. Five subgroup papers are included: Space Heating and Cooling, by Arnold Cohen; Electric Power Generation, by L.L. Vant-Hull; Hydroelectric Power Generation, by Frederick H. Warren; Wind Energy Systems, by W. H. Hurlebaus; and Ocean Thermal Energy Conversion, by E. Lee Leventhal. A Review of Solar Energy Resources was presented by Dwain F. Spencer. (MCW)

25989 (FEA/E—76/302) **Analysis of state solar energy policy options.** Jones, R.G.; Sramek, H.M.; Pelster, J.M. (National Conference of State Legislatures, Washington, D.C. (USA). Special Task Force on Energy). Jun 1976. 48p. NTIS $4.00.

Criteria needed by state governments for considering actions to stimulate the solar market are evaluated. Discussed in this report are solar market economics, tax incentives, and solar energy and electric utilities. The results of this study strongly imply that the state policy most significantly affecting solar thermal market penetration rates is the establishment of electric utility rate structures. A second implication of this study is that states should consider the use of solar thermal systems for space conditioning and water heating in state owned buildings. The third policy implication for state government is participation with the Federal government in the establishment of State Solar Energy Commercialization Programs. (15 references) (GRA)

25990 (R—835) **Solar heating of buildings and domestic hot water.** Beck, E.J. Jr.; Field, R.L. (Naval Civil Engineering Lab., Port Hueneme, Calif. (USA)). Jan 1976. 90p. Civil Engineering Laboratory, Naval Construction Battalion Center, Port Hueneme, CA 93043 free.

The purpose of this document is to provide guidance in the design and cost analysis of solar heating systems for buildings and domestic hot water (DHW). The nature of solar radiation, several types of solar systems, storage devices, and architectural considerations are among topics included. Calculation methods are included for determining collector size, storage size, simplified building and DHW loads, value of fuel saved, and saving-investment ratios. The calculation procedure is based on parametric curves for 'fraction of heating load supplied by solar energy' and several 'rules of thumb' for design. A series of 11 worksheets is used to enable the engineer with no prior experience with solar systems to accomplish a complete design and cost analysis. With this information he can prepare bidding and specification documents for the job. Tables of solar insolation at various Navy stations, typical building heat loads, collector prices by type, and storage tank prices are included. Two example problems are worked for tube-in-sheet collectors: one for space and DHW heating for a single dwelling, and the other for DHW supply for a dispensary. Neither was found to be cost effective when competing against present day prices for natural gas. A directory of manufacturers and bibliography is also included. (53 references) (auth)

25991 **Role of simulation in the development of solar energy systems.** Schrenk, G.L. (Univ. of Pennsylvania, Philadelphia). pp 176-195 of In Energy: mathematics and models. Roberts, F.S. (ed.). Philadelphia; Society for Industrial and Applied Mathematics (1976).

From Energy: Mathematics and Models; Alta, UT (7 Jul 1975).

The role that mathematical simulation can play in the design and development of solar energy conversion systems is discussed in this paper. Specifically, two types of solar systems are treated: 1) central station solar-thermal power systems utilizing solar concentrators; and 2) heating and cooling systems for buildings. Simulation consists of more than a series of isolated mathematical models of idealized physical systems; it must consider all facets of the design, construction, testing, and operational use of solar systems. It is emphasized that the simulation of hypothetical systems, using numerous assumptions before construction, must be differentiated from the simulation of actual systems, using actual experimental data collected after construction. The correct use of the physical simulation methodology, described in this paper, can result in substantial savings in both time and money. (13 references) (BYB)

25992 Economic contribution of 'artificial upwelling' mariculture to sea-thermal power generation. Roels, O.A. (City Coll., New York). Contract E(11-1)-2581. *Aware;* No. 70, 2-5(Jul 1976).

Deep-sea water has two valuable properties: it is uniformly cold and, compared to surface water, it is rich in nutrients such as nitrate and phosphate which are necessary for plant growth. In tropical and subtropical areas, the temperature difference between the warm surface water and the cold deep water can be used for sea-thermal power generation or other cooling applications such as air-conditioning, ice-making, desalination, and cooling of refineries, power plants, etc. Once the deep water is brought to the surface, utilization of both the cold temperature and the nutrient content is likely to be more advantageous than the use of only one of them. Claude demonstrated the technical feasibility of sea-thermal power generation in Cuba in 1930. The technical feasibility of artificial upwelling mariculture in the St. Croix installation has been demonstrated. Results to date demonstrate that the gross sales value of the potential mariculture yield from a given volume of deep-sea water is many times that of the sales value of the power which can be generated by the Claude process from the same volume of deep water. Utilizing both the nutrient content and the cold temperature of the deep water may therefore make sea-thermal power generation economically feasible.

GEOTHERMAL

REFER ALSO TO CITATION(S) 25681

25993 (CONF-750720—, pp 59-86) **Geothermal energy resources.** Sep 1975.

From Conference on the magnitude and deployment schedule of energy resources; Portland, Oregon, USA (21 Jul 1975).

In Magnitude and deployment schedule of energy resources.

Geothermal energy may be considered to be the thermal energy contained in the upper 10 km of the earth's crust, which has a mean temperature gradient between 20 to 30°C/km, a mean emissive heat flux of about 1.5 μcal/cm^{2}sec, and a heat content above 15°C of some 3 x 10^{25} cal, of which about 6 x 10^{24} cal is under the United States. This resource base is equivalent to the heat content of 8 x 10^{14} metric tons of coal or 5 x 10^{18} kWh, representing about 375,000 times the forecasted U.S. total electric power production for the year 1985. Unfortunately, geothermal heat in the outer 10 km of the earth's crust is too diffuse to be exploitable as an energy resource on a worldwide basis. Resources suitable for commercial exploitation may be defined as localized geologic deposits of heat concentrated at attainable depths, in confined volumes, and at sufficient temperatures for intended utilization. Although geothermal resources have been developed largely for generation of electric power, utilization of geothermal resources for non-electrical purposes such as space or industrial heating, desalination of water, and mineral recovery may be of great value in conserving fossil and nuclear fuels. Environmental impacts of geothermal energy are discussed. Legal problems associated with geothermal resources vary from state to state. Three subgroup papers include: Wet and Dry Steam Systems, by David L. Williams; Hot Dry Rock Systems, by William E. Brigham; and Geopressured Systems, by Myron Dorfman. A Review of Geothermal Energy Resources was presented by Geoffrey Robson. (MCW)

OTHER

REFER ALSO TO CITATION(S) 25516, 25526, 25527, 25528, 25538, 25540, 25541, 25554, 26358

25994 (RED—75-326) **Using solid waste to conserve resources and to create energy: Environmental Protection Agency. Report to the Congress by the Comptroller General of the United States.** (General Accounting Office, Washington, D.C. (USA)). 27 Feb 1975. 78p. U.S. General Accounting Office, Distribution Section, P.O. Box 1020, Washington, DC 20013 $1.00.

With landfill space becoming exhausted and incineration being restricted, solid waste management is becoming the primary environmental problem in both cost and public concern. This report examines the progress made in resource recovery implementation since the enactment of the Resource Recovery Act of 1970. The Federal Government, specifically the Environmental Protection Agency (EPA), needs to expand its efforts in assisting states and local communities in establishing resource recovery systems. Several economic issues have hampered resource recovery development (e.g., possible discrimination in freight rates for recovered materials; Federal procurement policy toward products containing recovered and recycled materials; and taxes which favor virgin materials over secondary materials). EPA was slow in developing the resource recovery program called for in the 1970 Act. The Act provided for Federal grants to finance the demonstration of resource recovery systems. Grants of approximately $20.4 million have been awarded for four resource recovery demonstration projects to Lowell, Massachusetts; San Diego County, California; Baltimore, Maryland; and the State of Delaware. The production of energy from solid wastes has recently been considered by about 38 communities. It is estimated that 2% of the U.S. energy needs could be saved through recycling available steel, aluminum, and paper wastes. In addition, if energy were recovered from municipal wastes throughout the U.S., the energy produced would equal 1.5% of the country's total energy consumption. (BYB)

25995 How much energy and material from waste and biomass. *Energy (Stamford, Conn.);* 1: No. 3, 9-13(1976).

Taken largely from a speech given at 1976 Capturing the Sun through Bioconversion conference: processes for the conversion of solid wastes and biomass fuels to clean energy forms, by George L. Huffman, Chief of the Fuels Technology Branch, EPA, Cincinnati, Ohio.

In the U.S., 570 to 800 million tons of dry combustible solid waste are discarded each year by municipalities, agriculture, and industry. This represents an energy loss of about 12 percent of total U.S. energy requirements. Urban-generated waste is available in a more concentrated form at appropriate locations; wastes from manufacturing or agricultural operations are more often generated in widely dispersed areas. Assuming 100 ton/day capacity plants, a revised estimate, due to geographical dispersion, works out to about 3 percent of total U.S. energy requirements that could be supplied by solid waste. This figure also includes the energy savings which would have been realized by the salvaging of materials through re-use technology (3 percent = 2 quadrillion BTU's/yr). New avenues of research deal with the biomass area—the large-scale growing of special land and ocean crops for conversion to energy. Projections of biomass potential tend to be purely speculative but promising. Huffman states that only about 5.6 percent of the land area of the U.S., or 169,000 square miles, would be required to supply the current demand for natural gas, if biomass yield could approximate 50 tons/acre-year. Over 100 cities in the U.S. are actively engaged in the assessment of their own urban solid waste as a low-sulfur energy source. At the municipal level, re-use technologies have been given impetus by diminishing land-fill areas for solid waste disposal, and increasingly stringent, legislated standards of environmental quality. Cost/benefit ratios, greatly dependent on local conditions, will determine if a project is raised from demonstration status to full-scale operation. The various processes under development by government and industry for recoverying energy from solid waste are combustion, pyrolysis, and bioconversion processes. These are similar to those used to recover energy from land-grown biomass sources.

ENERGY CONVERSION

REFER ALSO TO CITATION(S) 25967

25996 Giant microwave bursts emitted from a field-emission, relativistic-electron-beam magnetron. Bekefi, G.; Orzechowski, T.J. (Department of Physics and Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev. Lett.;* 37: No. 6, 379-382(9 Aug 1976).

A magnetron operating at a wavelength of 10 cm has been constructed with six resonant cavities cut in a cylindrical anode block. A graphite cylinder acting as a field-emission cathode delivers ~12 kA in an accelerating radial potential of ~360 kV. The magnetic field directed along the diode axis is ~8 kG. Linearly polarized microwaves of 30 nsec duration at powers of ~1.7 GW are achieved. The conversion efficiency of electron energy into microwave is ~35%. (AIP)

25997 **High-efficiency high-average-power second-harmonic generation with $CdGeAs_2$.** Menyuk, N.; Iseler, G.W.; Mooradian, A. (Lincoln Laboratory, Massachusetts Institute of Technology, Lexington, Massachusetts 02173). *Appl. Phys. Lett.*; **29**: No. 7, 422-424(1 Oct 1976).

Average second-harmonic power at 5.3 μm exceeding 0.75 W with a 17% power conversion efficiency has been obtained by pumping a $CdGeAs_2$ crystal, cooled to near 77 K, with a Q-switched CO_2 laser. Average and peak conversion efficiencies of 21 and 30%, respectively, were achieved at a pulse rate of 1.5 kHz. In cw operation the crystal gave a second-harmonic output of 73 mW with a conversion efficiency near 0.5%. (AIP)

MHD GENERATORS

REFER ALSO TO CITATION(S) 25197

DESIGN AND DEVELOPMENT

25998 (SAND—76-5121) **PULSAR, an unconventional topping stage.** Tucker, W.K.; Leisher, W.B.; Cowan, M. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. Contract AT(29-1)-789. 25p. (CONF-760906—2). Dep. NTIS $3.50.

From 11. intersociety energy conversion engineering conference; State Line, Nevada, United States of America (USA) (12 Sep 1976).

The addition of an MHD stage to coal-fired power plants is being considered since this converter may be able to operate directly on the high temperature products of coal combustion. A new type of topping stage which could perform the intended role of the conventional MHD stage and which has several apparent advantages is described. This new topping stage may be used with either coal or oil-fired generating stations and is based on a linear reciprocating flux compression generator, called PULSAR. The electrical portion of PULSAR consists of a superconducting magnet, generator coil, piston-like armature, and pulse-to-60 Hz conditioning equipment. Armature velocity is maintained sufficiently high to assure that flux compression occurs. Calculations and experimental data show that a load electrical energy of approximately two times the superconducting magnet energy can be obtained for each cycle, by extracting about 40 percent of the kinetic energy from the armature. Preliminary calculations show that for a conventional plant overall thermal efficiency of 35 percent, addition of the PULSAR stage can easily increase overall thermal efficiency to 50 percent at a net output of 890 MW. PULSAR output is 580 MW while the conventional plant provides the remaining 310 MW. Peak temperature is 2060 K and exhaust is 1360 K. The 50 percent efficiency is not a maximum but could be increased by increasing either peak temperature or plant output or both. PULSAR is also applicable to smaller plants and could be built as a strap-on unit for existing plants.

THERMOELECTRIC GENERATORS

REFER ALSO TO CITATION(S) 25506

FUEL CELLS

MATERIALS, COMPONENTS, AND AUXILIARIES

25999 (BNWL-tr—178) **Properties of tungsten carbide in electrodes for fuel cells with acidic electrolytes.** Binder, H.; Kohling, A.; Kuhn, W.; Lindner, W.; Sandstede, G. Translated from *Energy Convers.*; **10**: 25-28(1970). 10p. Dep. NTIS $3.50.

The preparation and performance of tungsten carbide catalysts for acid electrolyte fuel cells are described. Current densities were measured in the test cell for hydrogen, formaldehyde, acetaldehyde, formic acid, hydrazine, and carbon monoxide. Results are presented. (WHK)

PHOTOVOLTAIC CONVERTERS

REFER ALSO TO CITATION(S) 25546

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 25928, 25930

26000 **Government: expeditor of energy conservation and solar energy.** Ainscough, T.L. (Odell Associates, Inc., Charlotte, NC). pp 67-74 of In Application of solar energy. Wu, S.T. (ed.). Huntsville, AL; Univ. of Alabama (1975).

From Conference on applications of solar energy; Huntsville, Alabama, USA (Mar 1975).

See CONF-750351—.

A brief discussion is presented on three propositions as follows: energy conservation techniques as they are related to the built environment; constraints to the wide-spread application of energy conservation techniques; and suggested government expedition of energy conservation and utilization of alternate sources of energy in the built environment. (WDM)

BUILDINGS

REFER ALSO TO CITATION(S) 25576, 25580, 25583, 25910, 25929, 25931, 25932, 25934, 25935, 25979, 25988

26001 (COO—2560-1, pp 236-240) **Energy availability and the electric utility viewpoint.** Greiner, P.C. (Edison Electric Inst., New York). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

A brief discussion is presented on the various energy sources available to the electric utility. The advantages to a winter-peaking utility of the heat pump is mentioned. (WDM)

26002 **Thermal efficiency structure.** Bentley, R.P. US Patent 3,969,860. 20 Jul 1976. Filed date 31 Jul 1974. 8p.

A thermal efficiency structure is described that has a unique insulated double wall construction in which there is a minimum of connecting elements between interior and exterior wall surfaces and in which all surface components form lap joints with underlying structure, combined with extensive use of adhesives, such that both interior and exterior wall surfaces are air and moisture proof. Generally, a ventilation system containing a counterflow heat exchanger for recovery of ventilation thermal losses is an integral part of this structure.

RESIDENTIAL

REFER ALSO TO CITATION(S) 25582, 25601, 25623, 25631, 25978

26003 (CONF-760618—2) **Development of the ice-maker heat pump.** Fischer, H.C. (Oak Ridge National Lab., Tenn. (USA)). 1976. Contract W-7405-eng-26. 12p. Dep. NTIS $3.50.

From American Society of Heating, Refrigeration and Air-Conditioning Engineers annual meeting; Seattle, Washington, United States of America (USA) (27 Jun 1976).

The development of the ice-maker heat pump provides another tool to reduce the amount of energy it takes to heat and cool buildings. By using both the heating and cooling outputs of the heat pump, great energy savings can be made. The ice (cooling output) can be stored to meet air conditioning loads that occur during utility peak, thus, reducing peak demand as well as saving energy. Design features of the ice-maker heat pump are discussed.

26004 (COO—2560-1, pp 195-200) **Assessment of selected engine-driven heat pumps.** Wurm, J. (Inst. of Gas Tech., Chicago). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

As a result of questioning the relative energy-saving potentials of applying heat pumps to heating and cooling single-family residences, two possibilities readily emerge: 1. Saving energy by designing and operating the heat pump system and its components at conditions where optimal efficiencies are achievable; and 2. Saving energy by using the rejected heat of the driving (power) subsystem for heating. The validity of these premises is evaluated. (WDM)

26005 (COO—2560-1, pp 229-235) **Analysis approach to evaluate the impact of electric heating loads on utility operations.** Oplinger, J.L. (General Electric Co., Schenectady, NY). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

The objective of this paper is to present a general analysis approach which can be utilized to evaluate the impact of incremental electric heating loads on utility operations. Although the approach was developed to perform utility-specific economic evaluations and quantify utility impacts, it can also be used to assess consumer and societal impacts. Specifically, the analysis approach can be utilized to quantify the following impacts: 1. Utility impacts: load factor; capital investments; operating costs; annual revenue requirements; and minimum acceptable rates. 2. Customer impacts: annual energy costs. 3. Societal impacts: scarce fuel consumption; and primary energy consumption. (WDM)

26006 **Fuel saving device.** Troiano, J. US Patent 3,970,142. 20 Jul 1976. Filed date 18 Apr 1975. 2p.

A novel type of heat exchanger that pre-heats a fuel prior to being burned within a home furnace, so that the fuel burns better is claimed; the device consisting of a coiled tube running axially through a narrow pipe that extends transversely through a wide pipe, one of the pipes being located along a hot water line of the house that is used for washing, bathing and the like while the other pipe is along a house heating line such as for a baseboard hot water heating system, whereby use of either hot water line will preheat fuel moving through the coiled tube so that in effect the device forms a double heat exchanger.

OFFICE

REFER ALSO TO CITATION(S) 25603

TRANSPORTATION AND PROPULSION

REFER ALSO TO CITATION(S) 25932, 25936, 25981, 25982, 25983, 25986, 26498

26007 (ANL—76-XX-6) **Baseline energy consumption forecasts for transportation: a review and evaluation.** Koppelman, F.; O'Sullivan, P.; Collum, T. (Argonne National Lab., Ill. (USA)). May 1976. Contract W-31-109-Eng-38. 42p. Dep. NTIS $4.00.

A baseline projection of energy consumption is needed to estimate the potential energy savings from proposed transport technology and operational improvements. The Reference Energy System projection by Brookhaven National Laboratories and that which Stanford Research Institute produced for Gulf Oil are reviewed here. Attention is focused on the growth rate assumptions of the forecasts and the allowances made for the sensitivity of transport demand and technological efficiency to fuel price changes. The alternative trajectories of energy use are examined for automobile, bus and intercity air and rail passenger travel, and also for freight movement. Little, if any, justification can be found for many of the assumptions used to estimate transport demand and energy intensiveness. The assumptions underlying the Brookhaven National Laboratories projections are more explicit on changes in energy efficiency and energy price and shifts in transport patterns. However, the relationship of automobile travel, the largest component, to energy price is not specified clearly. The Stanford projection is based on seemingly arbitrary assumptions about changes in travel patterns and energy efficiency with no reference to the market process which must bring them about. It is concluded that the Brookhaven projection is a reasonable interim benchmark. Its structure should improve by refining and validating or revising the judgmental estimates on which it is based. This can be accomplished by identifying those judgements to which the energy consumption projections are most sensitive and modifying them, based on information presently available concerning the transport sector and/or information and relationships which can be developed by limited research.

26008 (ANL—76-XX-7) **Bibliography for transportation energy conservation.** (Argonne National Lab., Ill. (USA)). May 1976. Contract W-31-109-Eng-38. 64p. Dep. NTIS $4.50.

A listing is given of 578 reports, books, articles, and conference papers on transportation and energy. Coverage is primarily on U. S. developments and research from 1970 to 1975. Following a section of citations of general works on energy, the bibliography contains two main parts: "Energy for Transportation" and "Transportation of Energy." Within each of these topics the arrangement is multimodal (at the urban, regional, national, or international level), then by mode. Selected information sources are listed in the last part. Within each section, entries are arranged alphabetically by author or, lacking an author, by title. References were drawn from the Transportation Center Library collection and other libraries in the Northwestern University system. An earlier bibliography, Transportation and Energy, compiled by the Transportation Center Library in March 1974, forms the basis for the arrangement and provides coverage from 1970 to 1973.

AIR AND AEROSPACE

REFER ALSO TO CITATION(S) 26017, 26018

26009 (COO—2560-1, pp 191-194) **Large built-up heat pump systems.** Werden, R.G. (Robert G. Werden and Associates, Inc., Jenkintown, PA). 1975.

From Workshop on solar energy heat pump systems for heating and cooling; University Park, Pennsylvania, United States of America (USA) (12 Jun 1975).

In Solar energy heat pump systems for heating and cooling buildings.

Experience with large built-up heat pump systems is related. Some of the features which have made these larger custom-designed systems successful may well be applicable to the residential unit or system. Large commercial and industrial users only considered the systems because of favorable economics with pay-out. Comparative life cycle cost analyses were made, favoring a greater initial first cost investment in these systems. (WDM)

RAILWAY

REFER ALSO TO CITATION(S) 25984

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 25985, 26029, 26033

INDUSTRY

REFER ALSO TO CITATION(S) 25932, 25980

ENERGY SOURCES

REFER ALSO TO CITATION(S) 25988

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 26012, 26503, 26508

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 26556

RECYCLING

REFER ALSO TO CITATION(S) 26479, 26496, 26512, 26520, 26523, 26557

ELECTRIC POWER

REFER ALSO TO CITATION(S) 25972

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 25994, 26479, 26508, 26509, 26512, 26515, 26518, 26557

26010 (IS-T—611) **Study of iron and aluminum recovery from power plant fly ash.** Cavin, D.C. (Ames Lab., Iowa (USA)). Apr 1974. Contract W-7405-eng-82. 121p. NTIS.

A study of iron and aluminum recovery from power plant fly ash was performed to characterize a particular fly ash as a potential source of iron and aluminum. Magnetic separation of the iron-rich particles provided a fly ash fraction amenable to further iron extraction processes. Sulfuric acid leaching of the whole sample of fly ash as well as the fines (minus 200 mesh) showed a decrease in aluminum extractibility at increasing acid strengths. Lime sintering of the nonmagnetic fines revealed an increase in aluminum extractability at higher mole ratios of calcium oxide to

aluminum oxide. The primary crystalline aluminum bearing mineral in the fly ash sample studied was mullite, with trace quantities of calcium aluminates also being observed. In comparison to aluminum recovery from clays and other aluminous materials, fly ash is much more refractory in nature. Preliminary roasting of fly ash prior to sulfuric acid leaching reduced the aluminum extractability by reinforcing the refractory character of the ash.

26011 (LBL—4490) **Studies of lignin-degrading fungi and enzymatic delignification of cellulosic materials.** Carroad, P.A.; Wilke, C.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1976. Contract W-7405-Eng-48. 181p. Dep. NTIS $7.50.

Thesis.

The potential of microbially delignifying cellulosic wastes as a pretreatment to cellulose hydrolysis was assessed. Delignification enhances the enzymatic conversion of cellulose to glucose. Also, where cellulosic induction solids are used in cellulase enzyme production schemes, a greater degree of cell recycle and correspondingly increased productivity of enzyme is potentially possible when delignified material is used. Experiments were undertaken to test the use of culture filtrates and whole fungus cells in delignifying cellulosic materials, such as newsprint and groundwood. Cell-free culture filtrates, and solutions obtained by mechanically lysing microbial cells and pressing the residual solids to harvest intracellular fluid, were shown to be ineffective. Successful delignification was obtained only by culturing fungi directly on groundwood. Fermentation studies to determine growth rate and enzyme production optima as functions of temperature for the fungus Polyporus versicolor were completed. A composting-type process was designed and evaluated with respect to the operating costs and capital investment requirements for large-scale delignification.

26012 **Industrial and municipal sludge dewatering: THE Boeing BEST system.** Ames, R.K.; Peters, H.H.; Olson, R.L. (Boeing Aerospace Co., Seattle). pp 207-212 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

A proprietary process, the Boeing Extractive Sludge Treatment (BEST), is introduced that will materially reduce sludge handling problems and provide significant economic advantages. The system concept and present data examples obtained during a recently completed laboratory and pilot plant testing phase is presented. BEST utilizes unique properties of an aliphatic amine solvent to dewater organic and inorganic sludges that are then discharged as a bone dry solid and clear water effluent. During the process the sludge is sterilized and any associated oil is recovered. The reclaimed oil is available for use as an energy source or commercial byproduct. The system is totally enclosed to avoid pollution problems normally associated with large volume air discharge drying and incineration systems. Low energy requirements of the BEST system offer theoretical savings of 80 to 90 percent in comparison to conventional sludge drying systems. (PCS)

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 26008

INTERNAL COMBUSTION ENGINES

SPARK-IGNITION

26013 (PB—241780) **Evaluation of prechamber spark ignition engine concepts. Final report, Dec 1973—Jan 1975.** Roessler, W.U.; Muraszew, A. (Aerospace Corp., El Segundo, Calif. (USA)). Feb 1975. Contract EPA-R-802499-01. 239p. NTIS $7.50.

The report reviews the performance, emission, and operational characteristics of prechamber (or divided chamber), spark ignition engine concepts, including an analysis and evaluation of the applicability of these concepts to new automotive and stationary engines and retrofit installations. Relative to conventional automotive engines, prechamber engines exhibit very low carbon monoxide emissions accompanied by some reduction in the emission of nitrogen oxides. However, the hydrocarbon emission from prechamber engines is similar to that of conventional engines employing non-catalytic emission control systems, indicating a need for aftertreatment devices such as lean thermal reactors or catalytic converters. The fuel consumption of vehicles equipped with prechambers is similar to or slightly better than that of equivalent conventional vehicles at comparable levels of emission control.

DIESEL

26014 (N—75-20336) **Internal-combustion engine/vapour cycle combination.** Radwan, M.S. (Oxford Univ. (UK). Dept. of Engineering Science). Sep 1974. 406p. (OUEL—1097/74). NTIS $10.50.

Sponsored in Part by Inst. Of Mech. Engineers, Sci. Res. Council, and Cav LTD., London.

The possibility of using the heat rejected both in the cooling system and in the exhaust of an internal combustion engine for a vapor power cycle to increase the power production and the thermal efficiency of the combination is discussed. Heat transfer characteristics from cast iron and steel in distilled water and monochlorobenzene are presented, and the effect of nucleate boiling of the two liquids on the surface heat transfer properties of the two metals is dealt with. Diesel engine performance at elevated jacket temperatures with water and monochlorobenzene was determined. The performance to be expected at full and part load of a 1500 hp diesel engine with a water or monochlorobenzene vapor power cycle is compared.

TURBINE

REFER ALSO TO CITATION(S) 26020

STIRLING CYCLE

REFER ALSO TO CITATION(S) 26020

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 26015, 26033

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 26015

26015 (UCID—17098(Vol.1)) **Battery-flywheel hybrid electric power system for near-term application. Volume I. System description.** Davis, D.; D.; O'Connell, L.G.; Warner, S.E.; Raynard, A.E.; Rowlett, B.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1976. Contract W-7405-Eng-48. 52p. Dep. NTIS $4.50.

A description is given of a hybrid propulsion system design, based upon demonstrated technology, that will substantially improve performance, range, and consumer acceptability of a battery-powered electric vehicle. A newly demonstrated high-energy composite flywheel is coupled to an extremely simple, efficient, electro-mechanical transmission. Lead-acid batteries provide the prime power source. Interactive control of battery and flywheel drive power is provided by a versatile microprocessor-based power control unit. Efficient recovery of vehicle kinetic energy during braking, plus the energy base required to meet all high power transient demands, is provided by the flywheel. Battery demand is stabilized at a low average value resulting in improved battery performance through increases in both cycle life and available energy. Electric vehicle acceleration and range improvements due to the hybrid system described are predicted to be in excess of 80 percent for a vehicle operated in a stop-and-go commuter environment. This increase in performance is accompanied by a decrease in operating cost.

FLYWHEEL PROPULSION

26016 **Variable-inertia flywheel.** Lin, S.T. US Patent 3,968,593. 13 Jul 1976. Filed date 22 Aug 1974. 4p.

A vehicle carries a variable inertia flywheel which is mechanically connected to the road wheels of the vehicle. Change of inertia of the flywheel influences the motion of the vehicle in acceleration, deceleration, swerving.

VEHICLE DESIGN FACTORS

26017 (N—75-20291) **Evaluation of advanced lift concepts and fuel conservative short-haul aircraft. Volume 1. Final report.** Renshaw, J.H.; Bowden, M.K.; Narucki, C.W.; Bennett, J.A.; Smith, P.R. (Lockheed Aircraft Corp., Sunnyvale, Calif. (USA)). Jun 1974. Contract NAS2-6995. 312p. (NASA-CR—137525). NTIS $9.25.

Seri-2.

The performance and economics of a twin-engine augmentor wing airplane were evaluated in two phases. Design aspects of the over-the-wing/internally blown flap hybrid, augmentor wing, and mechanical flap aircraft were investigated for 910 m field length with parametric extension to other field lengths. Fuel savings achievable by application of advanced lift concepts to short-haul aircraft were evaluated and the effect of different field lengths, cruise requirements, and noise levels on fuel consumption and airplane economics at higher fuel prices were determined. Conclusions and recommendations are presented.

26018 (N—75-20292) **Evaluation of advanced lift concepts and fuel conservative short-haul aircraft. Volume 2. Final report.** Renshaw, J.H.; Bowden, M.K.; Narucki, C.W.; Bennett, J.A.; Smith, P.R. (Lockheed Aircraft Corp., Sunnyvale, Calif. (USA)). Jun 1974. Contract NAS2-6995. 367p. (NASA-CR—137526). NTIS $10.00.

Seri-2.

The performance and economics of a twin-engine augmentor wing airplane were evaluated in two phases. Design aspects of the over-the-wing/internally blown flap hybrid, augmentor wing, and mechanical flap aircraft were investigated for 910 m field length with parametric extension to other field lengths. Fuel savings achievable by application of advanced lift concepts to short-haul aircraft were evaluated and the effect of different field lengths, cruise requirements, and noise levels on fuel consumption and airplane economics at higher fuel prices were determined. Conclusions and recommendations are presented.

ENGINE SYSTEM

26019 (PB—237208) **Diesel fuel injection system: simulation and experimental correlation.** Bolt, J.A.; El-Erian, M.F.; Wylie, E.B. (Michigan Univ., Ann Arbor (USA)). Jan 1974. 58p. (EPA—460/3-74-001). NTIS.

A theoretical digital simulation of a conventional diesel fuel injection system was developed to study the problem of after-injection in diesel engines which results in increased exhaust emissions. The influence of wave propagation phenomena, pipe friction, and cavitation were included in the study. Computer results were compared with transient pressures measured on an actual fuel injection system operated on a test bench, and the comparisons showed the accuracy and validity of the simulation method. Analytical control methods were developed to help determine design means to control after-injection. One design change consisted of the addition of a control valve in the pump delivery chamber, while another involved the modification of the pump spill port. Pressures and flows were not significantly altered during the main injection period with either design change. The simulation program confirmed the ability of both design changes to control after-injection, and experimental data from a system with the pump spill port modified in accordance with theoretical design calculations provided satisfactory confirmation of the analyses.

26020 (TID—27086) **Automotive gas turbine ceramic regenerator design and reliability program. Second quarterly progress report.** Anderson, D.H.; Fucinari, C.A.; Rahnke, C.J.; Rossi, L.R. (Ford Motor Co., Dearborn, Mich. (USA)). 22 Apr 1975. Contract 68-03-2150. 96p. Dep. NTIS $5.00.

The primary objective of the EPA/Ford Ceramic Regenerator Design and Durability Program is to develop ceramic regenerator cores that can be used in passenger car gas turbine engines, Stirling Cycle engines, and industrial/truck gas turbine engines. Specific durability objectives are defined as achieving a B_{10} life of 10,000 hours on a truck/industrial gas turbine engine duty cycle. Operating experience, laboratory analysis, and mathematical analysis accumulated on the lithium-alumina-silicate (LAS) ceramic regenerator cores through the end of 1973 were previously reported. The test and analytical results acquired during 1974 are given, including descriptions of the material testing conducted magnesium-alumina-silicate (MAS) regenerator samples, analysis of core and rim designs, development of new regenerator core drive and support systems, and the results of over 18,000 hours of engine durability testing accumulated during 1974.

26021 **Carburetor deceleration emission control.** Furbacher, J.H. (to Ford Motor Co.). US Patent 3,957,022. 2 Sep 1975. vp.

A carburetor is described having separate primary and secondary air/fuel mixture induction passages each connected at one end to air at essentially atmospheric pressure and adapted to be connected at its opposite end to an engine intake manifold to be subject to the change in depression therein from a minimum level to a maximum vacuum force level occurring during engine deceleration conditions. A separate throttle valve is mounted for a rotatable movement across each of the passages between an open and closed position to control flow through the passage. One control is connected to the throttle valves to open the valves; the second is connected to the secondary induction passage throttle valve and operable independently of the first during engine deceleration to provide air/fuel mixture flow through the secondary induction passage.

EMISSION CONTROL

REFER ALSO TO CITATION(S) 26013, 26019, 26021

26022 (NASA-TM-X—3054) **Estimate of contribution of Jet Aircraft Operations to trace element concentration at or near airports.** Fordyce, J.S.; Sheibley, D.W. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). May 1974. 10p.

Samples of American Society for Testing and Materials Type A jet fuel were analyzed for trace element content by instrumental neutron activation techniques. Although 49 elements were sought, only aluminum, gold, indium, lanthanum, titanium, vanadium, barium, dysprosium, tellurium, and uranium were observed at levels above the detection limits. Only aluminum, titanium, and barium were present at concentrations greater than 0.1 ppm. Estimates of exhaust gas concentrations and the ambient contribution at or near airports calculated by using the Los Angeles International Airport dispersion model indicated that the ambient contribution is about an order of magnitude below typical urban levels for virtually all elements sought.

26023 (PB—237115) **Assessment of the applicability of automotive emission control technology to stationary engines. Final report.** Roessler, W.U.; Muraszew, A.; Kopa, R.D. (Aerospace Corp., El Segundo, Calif. (USA)). Jul 1974. 366p. (EPA—650/2-74-051; ATR—74(7421)-1). NTIS.

The emission characteristics of uncontrolled stationary diesel, spark ignition, and gas turbine engines are reviewed, and the applicability of automotive emission control technology to stationary engines are analyzed. Nitrogen oxides are the principal pollutant species emitted from these engines. Other pollutants include hydrocarbons, carbon monoxide, smoke, particulates, sulfur oxides, aldehydes, odor, and noise. The emission control techniques developed for these engines are applicable to stationary engines. These techniques include: engine derating; fuel injection and ignition timing retard; exhaust gas recirculation; catalytic converters; water injection; and engine component and operating conditions modifications. The emission reductions achieved with these techniques are accompanied by sizeable losses in specific fuel consumption and uncertainties relative to the effect of these techniques on engine life and control system durability.

26024 **Automotive sulfate emission data.** Somers, J.H. Research Triangle Park, NC; National Institutes of Health (1974). 32p.

From Meeting on health consequences of environmental controls: impact of mobile emissions controls; Durham, NC, USA (16 Apr 1974).

Automotive sulfate emissions were measured from catalyst and noncatalyst cars in a series of studies. While two investigations found significant sulfate formation in noncatalyst cars, three studies found only trace levels from noncatalyst cars. All of the investigations showed much higher quantities of sulfate emitted from catalyst cars. Pelleted catalysts had much lower sulfate emissions over low speed Environmental Protection Agency Federal Test Procedures than monolith catalysts. This was probably due to temporary storage of sulfates on the catalyst due to chemical interaction with the alumina pellets. The sulfate compounds were, to a large degree, emitted later under higher speed conditions which resulted in higher catalyst temperatures which decomposed the alumina salt. Future work will be directed towards further elucidation of this storage mechanism as well as determining in detail how factors such as air injection rate and catalyst location affect sulfate emissions.

26025 **Detoxication device for exhaust gases of internal combustion.** Poslek, S.; Pericki, V. US Patent 3,961,615. 14 Feb 1974. Priority date 20 Feb 1973, Yugoslavia. vp.

A detoxification device is described for an internal combustion engine having a carburetor feeding a fuel-air mixture to an

intake manifold of the engine, with the device interposed between the carburetor and the intake manifold. The device consists of: (1) a flat casing with an intake orifice; (2) a rectangular channel with a slidable shield; and (3) an operating means connected with the shield for selectively positioning the openings for secondary air in response to displacement of the accelerator.

26026 Engine exhaust system with monolithic catalyst element. Foster, M.R. (to General Motors Corp.). US Patent 3,957,445. 12 Jun 1974. vp.

The design is given of a catalytic converter adapted for use in an engine exhaust system with an exhaust conduit and a source of pressurized air. The catalytic converter consists of: (1) a cylindrical casing having a catalyst element seat and a pressurized air source; (2) a cylindrical monolithic catalyst element having a flow-reversing baffle; and (3) a coil spring compressed between a spring seat and the other end of the casing, so that the catalyst element is biased against the catalyst element seat. The spring is separated from contact with exhaust gases by the flow-reversing baffle and a cup-shaped member and is cooled by air flowing over it.

26027 Control system for exhaust gas purifying device. Goto, K.; Shibata, N. (to Toyota Jidosha Kogyo Kabushiki Kaisha). US Patent 3,957,444. 27 Dec 1974. Priority date 29 Dec 1972, Japan. vp.

A description is given of a gas purifying system having a catalytic converter for purifying gas from a source and a temperature control system. A by-pass directs a predetermined portion of the gas to be purified away from the converter, depending on the temperature of the converter. A valve is controlled by an electrical output which is the difference between a temperature sensor signal and the time derivative of that signal.

26028 Control of air pollution from new motor vehicles and new motor vehicle engines. Proposed selective enforcement auditing procedures. Train, R.E. *Fed. Regist.* (*Washington, D.C.*); **39**: No. 252, 46360-45380(31 Dec 1974).

A proposal to revise Part 85 of Title 40 of the Code of Federal Regulations by addition of a new subpart and amendments to existing subparts is given. The major purpose of the revision is to verify on a selective basis that new gasoline-fueled and diesel light duty vehicles and new gasoline-fueled and diesel light duty trucks conform at the assembly line with the regulations with respect to which the certificate of conformity was issued. Certification is the principal tool used for enforcement of emission standards and is based on the emission performance of a limited number of prototype vehicles. The regulations proposed will prevent future nonconformity so that prototype vehicle emissions will accurately reflect emissions from production vehicles. The new regulations involve Selective Enforcement Auditing (SEA). The regulations, the selection of vehicles for testing, test procedures, mileage accumulation, mile deterioration factors, sampling and inspection criteria, noncompliance with a test order, an example, and hearing procedures are reviewed.

NITROGEN OXIDES

REFER ALSO TO CITATION(S) 26032

26029 Evaluation of the MSU 4-cylinder conversion technique for V-8 engines. Report 75-11 DWP. Ann Arbor, MI; Office of Air and Waste Management (1974). 9p.

Mileage and emissions tests (1972 hot Federal Test Procedure) were performed on a 1968 Chevrolet Impala with a 307 cu in. V-8 engine modified to run on four cylinders only. The 1975 Federal Test Procedure could not be used in the evaluation due to cold start driveability problems. A 19 percent improvement in fuel economy was observed over the LA-4 driving cycle as a result of the 8-cylinder to 4-cylinder conversion. The vehicle was unable, however, to follow the trace during the high speed (57 mph) acceleration. Emissions of hydrocarbons and nitrogen oxides decreased 24 and 5 percent, respectively, while carbon monoxide emissions increased by 58 percent. Highway cycle results showed a 16 percent improvement in fuel economy and decreases in hydrocarbon and carbon monoxide emissions of 47 and 33 percent, respectively; nitrogen oxides increased by 36 percent. The carburetor modifications required for the cylinder number reduction conversion were capable of causing significant exhaust emission increases in the absence of exhaust emission testing for determining specific changes required for each vehicle/engine combination.

CARBON MONOXIDE

REFER ALSO TO CITATION(S) 26029, 26032

26030 Effect of cold weather on motor vehicle emissions. Polak, J.C. Ottawa; Air Pollution Control Directorate (1974). 44p.

The effect of cold ambient temperatures on exhaust emissions was examined by subjecting five vehicles (1972 or 1973 model years) with different engine displacements to the following types of emission tests: cold start, cold start with block heater operational, and cold start with extended idle. The vehicles were dynamometer-tested from a cold start, with start-up and operation over a 23-minute driving cycle comprising a complete test run. Hydrocarbon and carbon monoxide emissions increased substantially with decreasing ambient temperatures, with the increases being in excess of 100 percent when temperatures dropped from 60°F to 0°F. Engine coolant heaters substantially reduced the effect of cold weather on emissions. The practice of idling a vehicle after a cold start before driving away created more total emissions than driving the car immediately after starting.

26031 Use of a platinum porous fiber glass supported catalyst in an automobile exhaust gas system. Nicholas, D.M. Pittsburgh; Univ. of Pittsburgh (1975). 223p. University Microfilms Order No. 76-5468.

Thesis (Ph. D.).

The usefulness of a platinum impregnated porous fiber glass catalyst in a synthetic automobile exhaust gas system was investigated. Experimental data for conversions of carbon monoxide, ethylene, and propane were obtained at various preheat temperatures and space velocities. The preheat temperature was varied from approximately 180 to 560°C, and the gas hourly space velocity was varied from 20,000 to 70,000 $hour^{-1}$. The feed gas contained the major components of an actual engine exhaust. Preliminary results using platinized fiber glass catalysts showed that the catalyst bed had to be evenly and tightly packed in order to give a uniform flow distribution. Using three different pore size distributions of fiber glass catalyst, it was determined that the fiber glass catalyst with the largest average pore size (32 A compared to 12 and 11 A) and the most uniform distribution of pores (a similar volume percent throughout a pore radius range of 7 to 200 A) gave the highest conversions of all reactants at all operating conditions investigated. The results obtained with a platinized fiber glass catalyst were compared with those obtained with two conventional catalysts, platinized alumina beads and platinized silica gel beads under similar conditions. It was shown that under steady state conditions the fiber glass catalyst gave higher conversions of reactants than the conventional beads at low preheat temperatures. Under transient conditions, the fiber glass catalyst reached bed temperatures to initiate the reaction of carbon monoxide, ethylene, and propane with oxygen at a much faster rate than the ones obtained by the bead catalysts.

SULFUR DIOXIDE

REFER ALSO TO CITATION(S) 26031

HYDROCARBONS

REFER ALSO TO CITATION(S) 26029, 26030, 26032

PARTICULATES

26032 (PB—232682) Surveillance study of smoke from heavy-duty diesel-powered vehicles: southwestern U.S.A. (final report). Storment, J.O.; Springer, K.J. (Southwest Research Inst., San Antonio, Tex. (USA)). Jan 1974. 291p. (EPA—460/3-74-003). NTIS.

The effectiveness of the federal diesel smoke regulations in controlling smoke emissions from 64 heavy duty diesel engines engaged in routine automotive service was determined. The rate of smoke increase or deterioration was more dependent on how the miles were accumulated than on total mileage. The a and b smoke factors from the acceleration and lugdown portions of the Federal test were consistently related to engine make and model. At the end of one year of testing, 13 engines, or 20 percent of the trucks, registered smoke opacity in excess of either the a or b smoke limits for 1970. Twelve of the 13 engines exceeded the Federal limit during the full power lugdown portion of the test. Fifty-nine vehicles were tested for gaseous emissions of unburned hydrocarbons, carbon monoxide, and nitrogen oxides, and 43 engines, or 73 percent, met the 1973 California standards for heavy duty diesel engines. None of these engines met the 1975 California emissions standards.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 25256

26033 (UCRL—78066) **Supply and demand of fuel sources for automobiles.** Anderson, C.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 May 1976. Contract W-7405-Eng-48. 11p. (CONF-760342—1). Dep. NTIS $3.50.

From Symposium on alternate fuel resources; Santa Maria, California, United States of America (USA) (25 Mar 1976).

A review is given of the state of domestic oil depletion in context of projected world oil production. An optimized strategy for dealing with this problem is discussed. The strategy is based on the development of low cost synfuels and preparation for the introduction and utilization of these synfuels; i.e., smaller more efficient cars are needed that can utilize available synfuels. In addition, advanced batteries are required before electricity from coal and/or nuclear energy can be effectively utilized in transportation. Finally, the result of an economic analysis that indicates the nature of optimization of the overall strategy is given.

MATERIALS

REFER ALSO TO CITATION(S) 26931

26034 (TID—27070) **Surface and catalysis science in the Materials and Molecular Research Division.** Somorjai, G.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1976. Contract W-7405-Eng-48. 14p. Dep. NTIS $3.50.

Activities are reported in research programs on surface crystallography, alloy surface compositions, energy distribution in surface reactions, metal-surface catalysis of hydrocarbon reactions, synthetic fuel production by catalysis of CO and H following coal gasification, and solar energy conversion by Si cells and by photocatalysis. (JRD)

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 26919

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 25377, 25448, 25489, 26147

26035 (BDX—613-1227) **Feasibility of electroplating platinum—iridium alloy out of fused chlorides.** Harding, W.B. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1976. Contract E(29-1)-613. 18p. Dep. NTIS $3.50.

The feasibility of plating platinum and platinum-iridium alloys out of molten chloride salts was tested. Electrolysis and cyclic voltammetry studies were made of the eutectic mixture of lithium chloride and potassium chloride with and without additions of potassium tetrachloroplatinite(II) (K_2PtCl_4) and potassium hexachloroiridite(III) (K_3IrCl_6). Platinum was deposited at 100 percent efficiency from melts containing it. The deposit was dendritic, coarsely crystalline, noncoherent, and nonadherent. Deposits from melts containing both platinum and iridium were pure platinum (the iridium did not deposit) and had the same undesirable form as those from the melts containing platinum only. The deposition potential for iridium was found to be about 100 mV more negative than platinum. 6 figures.

26036 (IS-M—70) **Study of the purification of Gd by electrorefining.** Nagai, H.; Beaudry, B.J.; Gschneidner, K.A. Jr. (Ames Lab., Iowa (USA)). 1976. Contract W-7405-eng-82. 10p. (CONF-760706—4). Dep. NTIS $3.50.

From 12. rare earth research conference; Vail, Colorado, United States of America (USA) (18 Jul 1976).

Gadolinium metal can be prepared 99.98 percent pure by the calcium reduction of GdF_3 if (1) the reactants are highly purified, (2) the reactants and products are handled under inert conditions, and (3) the metal is vacuum melted at high temperatures followed by distillation. Since the process is costly in time and materials, an alternate method which would involve the electro-purification of crude gadolinium was studied. The electrolyte studied was LiCl:LiF:GdF_3. The best results were obtained using a 77.6 wt. percent LiCl, 11.2 wt. percent LiF, 11.2 wt. percent GdF_3 electrolyte at 700°C. It was shown that the purity of the deposit was strongly dependent on the purity of the electrolyte and the temperature. The purest deposit of Gd was obtained when the LiCl and LiF were purified by distillation and high purity GdF_3 was used. The effect of various methods used to remove the adhering electrolyte salts and to consolidate the deposited dendrites was studied. Removal of the adhering salts by distillation followed by arc melting of the dendrites gave the purest Gd. The analyses of the metal prepared under the various conditions are given.

26037 (IS-M—71) **Electrotransport of solutes in rare earth metals.** Carlson, O.N.; Schmidt, F.A. (Ames Lab., Iowa (USA)). 1976. 10p. (CONF-760706—5). Dep. NTIS $3.50.

From 12. rare earth research conference; Vail, Colorado, United States of America (USA) (18 Jul 1976).

A review of research on electrotransport in solid rare earth metals is presented. Information and data are included on principles of electrotransport, transport parameters for solutes in rare earth metals, and rare earth purification. (JRD)

26038 (JAERI-M—5829, pp 41-50) **Preparation of dislocation free Nb single crystals and their quality assessment by x-ray topograph.** Kamata, K. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

The completeness of dislocation-free Nb single crystals prepared by pedestal method was assessed by X-ray topography. The single crystals were prepared by drawing up from a Nb pedestal melted by electron beam bombardment. The vacuum of an electron beam melting furnace was 5×10^{-5} -- 1×10^{-5} Torr. The Nb pedestal of 15mm diameter was obtained from Teledyne Wah Chen Co. Crystals of 0.3 to 1.5 mm diameter and 30 to 50 mm long were obtained under the conditions of about 10 A filament current, 4 kV anode potential, 380 + 10 mA anode current, and at 0.2 to 0.5 mm/min rate of crystal growth. To handle very thin crystals as 0.5 mm was quite difficult. The vibration and deformation of the crystals were able to be avoided by clamping the suspended crystals at top and bottom with paraffin. Stereoprojection topograph and section topograph were taken by using 200, 101 and 111 reflection in order to examine the contrast change of image. The image requires dynamic interpretation. The number of dislocations reduces drastically, as the diameter of crystals decreases to less than 0.5 mm. It seems that there is no dislocation under the resolving power of topography. The defects smaller than the resolving power of X-ray topography have to be observed by electron microscope. Attention was paid to large difference of thus prepared Nb crystals from dislocation-free Cu single crystals.

26039 (LA-UR—76-1150) **Fabrication of uranium and uranium—titanium alloy penetrators of differential hardnesses.** Muller, J.F. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-eng-36. 16p. (CONF-760540—3). Dep. NTIS $3.50.

From Conference on high density alloy penetrator materials; Charlottesville, Virginia, United States of America (USA) (24 May 1976).

Penetrators of three different hardness levels were fabricated using unalloyed U and U—Ti alloys. Extrusion processes are described along with quenching and swaging. (JRD)

26040 (NLCO—1134) **Army Air Force MMT production of 0.65 to 0.85 Ti and quad depleted uranium alloys.** Polson, C.E.; Levy, L.M.; Schardt, R.L. (National Lead Co. of Ohio, Cincinnati (USA)). 1976. Contract E(30-1)-1156. 33p. (CONF-760540—5). Dep. NTIS $4.00.

From Conference on high density alloy penetrator materials; Charlottesville, Virginia, United States of America (USA) (24 May 1976).

This report concerns the less than 50 ton production of U—(0.65-0.85) Ti and quad (0.50 Ti, 0.75 Zr, 0.75 Mo, 0.75 Nb) alloys. It is presented as three parts: casting of low carbon alloy ingots, rolling of U—0.7 Ti ingots, and solution heat treatment and aging of wrought U—0.75 Ti and U—0.75 quad type alloys. (DLC)

26041 (NP—20946) **Trends in the production, utilization, and development of abrasion-resistant alloys in America.** Dodd, J. (Climax Molybdenum Co., New York (USA)). 1974. 21p. Climax Molybdenum Co., New York, NY.

A survey of abrasion resistant materials is presented. Sections are included on abrasion-resistant cast steels, abrasion-resistant wrought steels, alloy white irons, composite abrasion-resistant castings, grinding media, and development prospects. (JRD)

26042 (Y—2045) **Thin beryllium structures by powder metallurgy.** Northcutt, W.G. Jr.; Hovis, V.M. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). Jul 1976. Contract W-7405-eng-26. 22p. Dep. NTIS $3.50.

A process was developed for fabricating thin-wall beryllium shapes. The procedure includes plasma spraying a beryllium structure containing homogeneously dispersed silicon grains, removing any undesirable volatile substances from the structure, and sintering the plasma-sprayed structure within a sizing die system in a controlled atmosphere at optimum pressure and temperature.

26043 Applications of ion plating in metals fabrication. Bell, R.T.; Thompson, J.C. *Met. Finish.*; **72**: No. 4, 42-45, 49(Apr 1974).

Use of ion plating at the Oak Ridge Y-12 Plant to solve problems encountered in metals fabrication and processing are discussed. Three typical areas are covered. The first is the use of strike coats on various substrates for subsequent electrodeposition. The second area in which ion plating is shown to contribute to a process is in cold welding or room temperature bonding of metals. The third application involves plating U to promote safe handling, fission-product retention, and corrosion protection in nuclear reactors.

26044 Flyer plate adhesion tests for copper and nickel plated A286 stainless steel. Dini, J.W.; Johnson, H.R. (Sandia Labs., Livermore, CA). *Rev. Sci. Instrum.*; **46**: No. 12, 1706-1707(Dec 1975).

Flyer plate shock wave tests were used to evaluate the influence of using an intermediate copper electrodeposited coating on A286 stainless steel prior to plating to final thickness with nickel. Neither varying the copper plating solution (cyanide or pyrophosphate) nor the deposit thickness from 0.008 to 0.084 mm affected the adhesion.

26045 Use of eddy currents to measure thickness of nickel plating on carbon steel. Smith, J.H. (Oak Ridge National Lab., TN). *Mater. Eval.*; **34**: No. 6, 127-136(Jun 1976).

The use of eddy current techniques to measure the thickness of nickel plating on carbon steel is investigated. Factors examined are: different plating baths (Watts and Sulfamate), different substrates (A 285 and A 516 carbon steels), and the effects of using different types of eddy current instrumentation (phase sensitivity and amplitude sensitivity). The results show that the thickness of nickel plating (for the conditions described in this report) can be measured accurately using eddy current techniques, if proper procedures are followed. These procedures are described along with many other variables that are associated with tests of this type.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 26153

26046 (BNL—21505) **Structural studies of order, disorder and stoichiometry in some high T/sub c/ Nb-base A-15 superconductors.** Cox, D.E.; Moehlecke, S.; Sweedler, A.R.; Newkirk, L.R.; Valencia, F.A. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. Contract E(30-1)-16. 38p. (CONF-760543—1). Dep. NTIS $4.00.

From 2. conference on superconductivity; Rochester, New York, United States of America (USA) (19 May 1976).

X-ray intensity measurements have been made on several Nb-base A-15 type superconductors. Order parameters have been determined with reasonable accuracy even in the presence of substantial amounts of impurity phases. Chemically vapor deposited Nb_3Ge of near-stoichiometric composition is characterized by a significant amount of disorder, corresponding to occupation of about 4 percent of the Nb sites by Ge. Annealing at 1350°C converts this material to a Nb-rich A-15 phase and Nb_5Ge_3. The former has essentially no Ge on Nb sites. From the lattice parameter trends in these compounds and the A-15 region of the Nb-Pt system, a B site radius of 1.43A for Nb is proposed. This is significantly different from the A site radius of 1.51A and closer to the normal metallic twelve-coordinated value.

26047 (JAERI-M—5829, pp 51-56) **Study of magnetic domains by neutron topograph.** Hosoya, S.; Ando, M. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Observation of magnetic domain by neutron topography has been made. In the antiferromagnetic state of Cr, the arrangement of spin is sinusoidal spin density wave (SDW) structure. The magnetic satellite reflection by this SDW can easily be separated one by one. Photographs of the reflection make the states of Q and eta magnetic domains clear. Experiment was carried out with a neutron polaroid camera. Exposure time was 5 -- 20 min for nuclear scattering, and 10 -- 100 min for magnetic scattering. The resolving power of the system and the camera was 0.5 mm. Two kinds of crystals were used. A photograph taken with a good crystal made by sublimation is shown in a figure. From this data, it is said that Q and eta magnetic domains are large, the Q domain splits to a few eta domains, all magnetic walls are 90° walls, and single Q state is attained by cooling in a magnetic field. These results were reported at Moscow Conference, and Arrott made a comment on this report. His results concerning the eta domain was different from the present results. Fawcett will perform neutron small angle scattering experiment by using the same kind of sublimated Cr. Schlenker determined the distribution of the magnetic domain of Co-8% Fe by using polarized neutrons.

26048 (JAERI-M—5829, pp 75-86) **Many-beam effects in electron microscope images of lattice defects.** Izui, K.; Nishida, T.; Furuno, S.; Otsu, H. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Multi-beam effects in electron microscopic images were investigated. A computation program was developed on the basis of a matrix theory of the multi-beam effects. The matrix theory for a perfect crystal and an imperfect crystal is described, and expression for absorption coefficient is presented. The amplitude of electron wave penetrating through lattice defects is expressed by using scattering matrices which correspond to crystal slices. Calculation of extinction distance was performed, and compared with experimental results. In case of systematic reflection, the difference between two beams and from four to eight beams approximation was small, while a large effect was seen in case of accidental reflection. The intensity profile of bend contour was calculated for silicon and copper-aluminum alloy. Distance between submaxima becomes short with increase of thickness. The change in stacking fault fringes with diffraction condition was investigated. Samples were copper-aluminum alloy. Systematic behavior of the fringes was obtained, and the calculated results reproduced experimental ones.

26049 (JAERI-M—5829, pp 57-74) **On neutron topograph.** Tomimitsu, H. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Results of neutron topography on a Ge single crystal are described. The neutron source was a horizontal experimental hole of JRR-3 of Japan Atomic Energy Research Institute. Neutrons of the wave length of 1 -- 2A were selected for the experiment. The sample was a Ge crystal containing a small amount of phosphorus, which was made as a transistor. Press was applied at 75 kg/cm² of pressure in <110> direction at 850°C. The sample satisfied kinematical condition. As for a converter system, a Rh plate of 1/100 inch thick, an X-ray film, and a Gd foil of 1/500 inch thick were arranged. The resolving power of the system was about 40 μ. Patterns of overall contrast variation due to hot-press are shown in figures. Distortion field arose along the direction of press unevenly. Difference of image quality due to wave length was investigated. Topographs with longer wave length shown better contrast and better resolving power. Collimation of neutron beam seems to be necessary. Various techniques were tried to obtain stereoscopic view of distortion field. Uneven distribution of distortion was confirmed. The same results were also obtained from X-ray topography. The kinematical interpretation of taken topographs was possible. Evaluation of the resolving power of neutron topography is described in Appendix.

26050 Structure of amorphous Gd—Co alloy films. Wagner, C.N.J.; Heiman, N.; Huang, T.C.; Onton, A.; Parrish, W. (IBM Research Lab., San Jose, CA). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 188-189(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Co—Gd alloys films with 77-23 and 68-32 atomic ratios (no bias) and with 77-17-6, Co—Gd—Ar (-100 V bias on substrate) were prepared by bias sputter deposition on 50 μm thick Be substrates. Within experimental uncertainties, the interference function, I(K), obtained from reflection and transmission of Mo—Kα radiation by a given sample was identical. A comparison of G(r) for various compositions leads to an identification of the resolved components of the first maximum as Co—Co, Co—Gd, and Gd—Gd nearest neighbors at r = 2.5, 2.95, and 3.45A, respectively. At larger values of r (greater than or equal to 6A), G(r) of the biased film has greater peak heights than G(r) of the unbiased films, suggesting longer range structural coherence in the biased film.

26051 Equation of state for the Ce/sub 1-x/Th/sub x/ valence transition. Lawrence, J.M.; Croft, M.C.; Markovics, J.M.; Parks, R.D. (Univ. of Rochester, NY). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 429-430(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The valence transition in Ce/sub 1 - x/Th/sub x/ is isomorphic, and, hence, analogous to a liquid-vapor transition (the order parameter being the volume V); and it exhibits mean-field behavior. It is found that in the critical region the x - T phase boundary is nearly parallel to the x-axis, and that the data for resistivity R (which couples linearly to the order parameter) fits a Landau equation of state of the approximate form $0.35\,(\Delta R/R_0)^3 + 0.67\,(\Delta x/x_0)(\Delta R/R_0) = \Delta T/T_0 - 0.07\,\Delta x/x_0$. This is in analogy to a mean-field ferromagnet with (M,H,T) approximately (V,T,x); consequently dR/dT parallel/sub max/ approximately (Δx)/sup γ/ with $\gamma = 1$, as demonstrated by the data. The mean field nature is due to the electroelastic coupling associated with the large volume change. This coupling enters the free energy as the $\Delta x(\Delta V)^2$ term, which may reflect the dominance of anharmonic strain with increased alloying. Magnetic susceptibility and specific heat measurements reveal that both the average magnetic moment and entropy couple linearly to the order parameter. The latter finding is consistent with the existence of the term $-\Delta V \Delta T$ in the free energy as implied by the above equation of state.

26052 **Theory of random anisotropic magnetic alloys.** Lindgard, P.A. (AEC, Risoe, Denmark). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 29, 441-442(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

A mean field—crystal field theory is developed for random, multi-component, anisotropic magnetic alloys. It is especially applicable to rare earth alloys. A discussion is given of multicritical points and phase transitions between various states characterized by order parameters with different spatial directions or different ordering wave vectors. Theoretical predictions for the phase diagrams and magnetic moments, based on known parameters for the TbEr alloys, agree with experimental observations. A simple procedure to include fluctuation corrections in the mean field results is also discussed.

26053 **Thermodynamic behavior near valence instabilities.** Parks, R.D.; Lawrence, J.M. (Univ. of Rochester, NY). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 29, 479-483(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Recent work on the characterization of the second-order, mean-field, valence transition in Ce/sub 1 - x/Th/sub x/ is briefly reviewed. Extended work has culminated in the quantification of the Landau free energy functional which describes the transition. The understanding of the microscopic origin of the different terms in the free energy is illuminated by measurements of the specific heat and the effects of solutes of varying valence and atomic size. Results for thermopower and magnetic susceptibility are also presented and are utilized to characterize the integral and non-integral valence states. Throughout, comparisons are made with the SmS system.

26054 **Single crystal growth of $HoFe_2$ and $ErFe_2$.** Milstein, J.B. (Naval Research Lab., Washington, DC). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 29, 592-593(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The first single crystal growth of centimeter-dimension specimens of $HoFe_2$ and $ErFe_2$. These materials are cubic Laves phase compounds, which, as a class, exhibit such properties as magnetic anisotropy, large magnetostriction, and spin reorientations. The present crystals, of as much as 15 gm mass, make possible single crystal neutron diffraction and magnetostriction measurements. The starting compounds prepared from 99.9 percent rare earth ingot and 99.95 percent iron rod, were melted together in electric arc or radio frequency induction furnaces. Single crystals were grown by the Czochralski technique, using an electric arc-powered furnace, under gettered argon atmosphere. $HoFe_2$ and $ErFe_2$ behave as congruently melting compounds, and grow under similar conditions. The crystals produced have been examined by x-ray and neutron diffraction, which show (1) the absence of structure on the neutron diffraction rocking curve peaks and (2) mosaic spreads of not more than 0.3°. The very high quality of the specimens obtained may be deduced from these results.

26055 **Metallographic method for the determination of crystal alignment in Co—R permanent magnets.** Martin, D.L. (General Electric Corporate Research and Development, Schenectady, NY). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 29, 614-615(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

A metallographic method was developed for determining the alignment of grains in sintered cobalt-rare-earth permanent magnets. The basis for the method is to use the eutectoid transformation of the Co_5R phase to decorate the basal planes, and thus enable one to determine some information on the orientation of the grain with respect to the alignment direction. The method was used to study the degree of alignment in aligned and unaligned Co—Sm magnet samples. It is shown that it is possible to obtain quantitative grain alignment results which compare favorably with alignment data obtained from magnetic measurements and x-ray diffraction.

26056 **Spin reorientation in $NdCo_5$ single crystals.** Ohkoshi, M.; Kobayashi, H.; Katayama, T.; Hirano, M.; Tsushima, T. (Waseda Univ., Tokyo). *AIP (Am. Inst. Phys.) Conf. Proc.;* No. 29, 616-617(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

A magnetic study was done precisely on single crystals of $NdCo_5$ from a standpoint of the spin reorientation (SR). The easy axis rotates continuously from the b-axis [10.0] at lower SR temperature (T/sub SR1/ at 245°K) to the c-axis [00.1] at upper SR temperature (T/sub SR2/ at 285°K) in the bc-plane. The temperature variations of the magnetocrystalline anisotropy constants K_1, K_2, and K_4 determined precisely from the magnetization and torque curves show that K_1 changes its sign from negative to positive just at T/sub SR2/ and K_2 from positive to negative at a little higher temperature than T/sub SR2/, but that $(K_1 + 2K_2)$ reverses its sign exactly at T/sub SR1/. Further, it is found that the anisotropy constant in the basal plane K_4 vanishes near T/sub SR2/, though it is fairly large (approximately 10^7 erg/cm^3) at low temperatures. On account of this anisotropy change, the magnetization curve along the a-axis [11.0] has a peak at a temperature slightly higher than T/sub SR1/ when effective field of more than 10 kOe is applied.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 25764, 25765, 25811

26057 (ANL—76-40) **Application of frequency-modified life approach to the low-cycle fatigue behavior of Type 304 stainless steel.** Maiya, P.S.; Majumdar, S. (Argonne National Lab., Ill. (USA)). May 1976. Contract W-31-109-Eng-38. 15p. AT.

The application of the frequency-modified life equation to fatigue life prediction was critically examined using the extensive fatigue data generated for Type 304 stainless steel at 1100°F (593°C) under a variety of cyclic-loading conditions. The parameters that enter into the frequency-modified life equation vary with strain rate and show a transition coinciding with the frequency of cycling at which a change in the fracture appearance from predominantly transgranular to predominantly intergranular failure mode or vice versa occurs. The accuracy in life prediction is improved when the effect of strain rate on life-predictive parameters is considered. It is shown how the effect of compressive and symmetric hold time on fatigue life can be taken into account. A comparison between the frequency-modified life approach of Coffin and the damage-rate approach recently developed by Majumdar and Maiya is also made to show the importance of waveshape effects on low-cycle fatigue life.

26058 (BNWL-SA—5586) **Deformation of uranium, neptunium, and plutonium.** Merz, M.D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 4 May 1976. Contract E(45-1)-1830. 6p. (CONF-760819—5). Dep. NTIS $3.50.

From 2. international conference on the mechanical behavior of materials, Federation of Materials Societies; Boston, Massachusetts, United States of America (USA) (16 Aug 1976).

The mechanical properties and deformation mechanisms of the three actinide metals uranium, neptunium, and plutonium are discussed and compared with more conventional metals. These metals have low symmetry crystal structures at room temperature and exhibit unusual deformation modes in addition to slip including twinning, grain boundary sliding, kinking and strain-concurrent recrystallization.

26059 (COO—2733-3) **Inelastic analysis of metallic structures in the presence of thermal gradients using newer constitutive relations.** Kumar, V.; Mukherjee, S. (Cornell Univ., Ithaca, N.Y. (USA)). Feb 1976. Contract E(11-1)-2733. 40p. (CONF-760905—4). Dep. NTIS $4.00.

From International joint pressure vessels and piping and petroleum mechanical engineering conference; Mexico City, Mexico (19 Sep 1976).

Several newer constitutive relations have recently been proposed for describing the mechanical behavior of metals and alloys under elevated temperature creep conditions. A salient feature of the mathematical structure of many of these relations is that they typically express the nonelastic strain rates as functions of the current values of stress, temperature, and some other suitably defined state variables. A computational scheme is presented for the inelastic analysis of metallic structures subjected to both mechanical and thermal loadings and obeying constitutive relations of the type described above. Several numerical examples for the creep of thick-walled spheres, cylinders, and rotating discs in the presence of thermal gradients are presented. The particular constitutive relations used in these calculations are due to Hart. The proposed computational scheme is found to be very efficient from the view point of both computational time and effort. The effects of previous cold work on the stress redistribution and creep of these structural elements are discussed.

26060 (HEDL-TI—76005) **Cold work effects: a compilation of data for types 304 and 316 stainless steel.** Moen, R.A.; Duncan, D.R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Mar 1976. Contract E(45-1)-2170. 273p. Dep. NTIS $9.00.

Effects of cold working on the mechanical properties of Types 304 and 316 stainless steel are tabulated, illustrated, and summarized. The properties covered are those that affect the setting of Code allowable stresses. Effects on other properties that indirectly affect the utilization of cold worked materials are also discussed. The report provides in summary the basis for formulating guidelines or rules to govern the use of cold worked materials in various types of components and construction.

26061 (ORNL/TM—5329) **Mechanical property correlations for 2 1/4 Cr—1 Mo steel in support of nuclear reactor systems design.** Booker, M.K.; Hebble, T.L.; Hobson, D.O.; Brinkman, C.R. (Oak Ridge National Lab., Tenn. (USA)). Jun 1976. Contract W-7405-eng-26. 32p. AT.

In recent years, 2 1/4 Cr-2 Mo steel has gained worldwide importance as a structural material for use in steam generators. Therefore, it is important that the mechanical properties of this material be understood in some detail. A large collection of mechanical properties data for this material has been compiled from the literature and from private sources. Analysis of these data has yielded mathematical descriptions of the tensile, creep, fatigue, and impact properties of annealed and isothermally annealed 2 1/4 Cr-1 Mo steel. Where appropriate, statistical analysis has been performed to yield estimates of possible variations in behavior. The final results represent a comprehensive description of the mechanical behavior of the material. This description makes a large contribution to the characterization required for use of 2 1/4 Cr-1 Mo steel in the construction of nuclear systems.

26062 (ORNL/TM—5399) **Empirical relationships among creep properties of four elevated-temperature structural materials.** Booker, M.K.; Sikka, V.K. (Oak Ridge National Lab., Tenn. (USA)). Jun 1976. Contract W-7405-eng-26. 71p. AT.

Elevated-temperature creep and creep-rupture data for four important structural materials are examined to determine empirical relationships among various properties. Materials used include types 304 and 316 austenitic stainless steel, ferritic 2 1/4 Cr-1 Mo steel, and nickel-base Inconel alloy 718. Results obtained allow use of rupture life and minimum creep rate data to predict time to tertiary creep, creep ductility, and creep strain-time response. Such predictions are useful since in general more data are available for rupture life and minimum creep rate than for other properties.

26063 (ORNL/TM—5403) **Predicting the strain to tertiary creep for elevated-temperature structural materials.** Booker, M.K.; Sikka, V.K. (Oak Ridge National Lab., Tenn. (USA)). Jul 1976. Contract W-7405-eng-26. 65p. AT.

The creep strain incurred before the onset of tertiary creep can be an important design criterion in the use of elevated-temperature structural materials. Various methods for predicting the amount of this strain are discussed. Application of these methods to data for types 304 and 316 austenitic stainless steels, nickel-base Inconel alloy 718, and ferritic 2 1/4 Cr-1 Mo steel is presented, with generally good results. The behavior of these four materials, including variations among different materials, is discussed in terms of basic material characteristics.

26064 (PNC-N—241-74-13) **Notch rupture properties of the stainless steel as the structural material for the Japanese experimental fast reactor. Type 304 thick plate, base metal and welded joint.** Yoshimura, H.; Yokoi, S.; Monma, Y.; Ichino, I.; Uematsu, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Dec 1974. 45p. (In Japanese). INIS.

A series of notch rupture tests at 500, 550, 600 and 650°C up to 20,000 hrs was carried out for the Type 304 stainless steel plate, base metal and submerged arc welded joint, which is equivalent to the material for the reactor vessel of the Japanese Experimental Fast Reactor "JOYO". The results showed that the joint efficiency for creep rupture strength on smooth specimens decreases with increasing test temperature and longer rupture times. Notch strengthening was observed for both the base metal and the welded joint.

26065 (SAND—76-5442) **Mechanical equation of state for inelastic solids.** Rohde, R.W.; Swearengen, J.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 5p. (CONF-760819—4). Dep. NTIS $3.50.

From 2. international conference on the mechanical behavior of materials, Federation of Materials Societies; Boston, Massachusetts, United States of America (USA) (16 Aug 1976).

A mechanical equation of state for metals must have at least one evolutionary variable or history-dependent material property. The ability of three analytic relationships (Hart equation, reaction rate model, and power law) to meet the criteria is tested using stress relaxation in high-purity iron and Sn—50 percent In alloy. (DLC)

26066 (SAND—76-5443) **Short-time, high temperature mechanical testing of electrically conductive materials.** Marion, R.H.; Karnes, C.H. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 5p. (CONF-760819—3). Dep. NTIS $3.50.

From 2. international conference on the mechanical behavior of materials, Federation of Materials Societies; Boston, Massachusetts, United States of America (USA) (16 Aug 1976).

The design and fabrication of a system to obtain information on short-time high temperature properties of materials are described. Components of the system are described in sections on load application, specimen heating temperature measurement, longitudinal temperature gradient, and strain measurement. Results of tests using stainless steel and graphite specimens are included. (JRD)

26067 (WARD-HT—3045-13) **Design and analysis of multiaxial cylindrical creep test specimens.** Mallett, R.H.; Dhalla, A.K.; Yocolano, J.T. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Apr 1976. Contract E(11-1)-113045. 126p. AT.

The procedures, calculations, and computer programs developed for handling data in a high temperature creep testing project are described. Tubular specimens, nominally 1.6 inch inside diameter and 1.8 inch outside diameter, fabricated from austenitic stainless steel were tested at constant elevated temperature [1100°F] under constant (and stepped) combined axial and pressure loadings. For these and similar tests, the resulting semi-automatic system is useful for data acquisition, storage, retrieval, processing, display of creep curves, and generation of creep equation constants. A principal purpose of the report is to explain, by example, that the design of a multiaxial creep test must encompass design analyses to assure that the content and completeness of the records support the test objectives. In such tests the experimenter and the analyst must not operate independently as would be the practice in more routine testing.

26068 **Magnetoelastic contributions to the elastic constants of holmium, dysprosium, and terbium.** Gama, S.; Kale, B.M.; Torikachvili, M.S.; Ferreira, O.; Arellano, M.; Pinatti, D.G.; Donoho, P.L. (Instituto de Fisica Teorica, Sao Paulo, Brazil). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 596-597(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The magnetoelastic contributions to the elastic constants of Ho, Dy, and Tb were determined at temperatures in the paramagnetic range in applied fields up to 75 kG. Magnetization measurements were also made in order to facilitate the comparison of the experimental results with theory. Initially the results were analyzed in terms of a theory due to Southern and Goodings, but the agreement was poor. The field dependence predicted by this theory, using magnetoelastic coupling constants estimated from static magnetostriction data, was generally much smaller than the observed dependence, and, in many cases, the theory did not predict the correct qualitative field or temperature dependence. The reasons for these discrepancies are, apparently, the use by Southern and Goodings of first-order perturbation theory, together with an inappropriate application of finite-strain theory. A calculation of the magnetoelastic contribution to the elastic constants was carried out employing the molecular-field approximation, but without using perturbation theory and using only the conventional small-strain tensor. This approach, similar to that of Freyne, is in much better agreement with the experimental results.

26069 Magnetoplastic deformation of Dy crystals. Liebermann, H.H.; Graham, C.D. Jr. (Univ. of Pennsylvania, Philadelphia). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 598-599(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

It has been reported that if single crystals of Dy or Tb are magnetized in fields of order 100 kOe parallel to a magnetic hard direction at 4.2°K, a permanent plastic deformation occurs. Neither the cause nor the mechanism of this deformation has been found. This phenomenon was investigated in Dy crystals, using optical and electron microscopy, x-ray diffraction, and magnetic measurements. Plastic deformation is found to occur generally at 70 to 90 kOe at 4.2°K in Dy; the mechanism is mechanical twinning on the (10 anti 1 2) [10 anti 1 1] system, which was determined by independent mechanical tests to be the primary twinning system. The magnetic properties (coercive field, apparent anisotropy) are permanently changed by the deformation, as would be expected. The most likely driving force for the deformation appears to be the decrease in magnetic energy of the twins, which are oriented with an easy [10 anti 1 0] direction almost parallel to the field. A calculation shows that this energy difference leads to an equivalent stress comparable to the yield stress of Dy. Another possibility is that the magnetostrictive strain simply exceeds the yield strain. The experiments and their interpretation are made difficult by the large magnetic torque acting on a sample that is not perfectly aligned in the field.

26070 Searching for an equation of state for the plastic deformation of stainless steel. Cook, J.H.; Walters, L.C.; Pitt, C.H. (Argonne National Lab., Idaho Falls, ID). *Scr. Metall.*; 10: No. 4, 335-340(Apr 1976).

A series of stress-strain-rate (family of constant hardness) curves have been generated at room temperature for 316 stainless steel. The curves were obtained by use of the stress-relaxation test using the technique developed by Hart. These curves are basically parallel and cover a ln strain rate range of -5.2 to -20.8 (strain rate of 5.5×10^{-3} to 9.3×10^{-10} s^{-1}). An arbitrary measure of hardness was established for each of the stress-strain-rate curves. An empirical equation was developed which described the applied stress as a function of strain rate and hardness. The hardness of the curves were in order with respect to the corresponding true strain. The family of curves represent evidence that an equation of state exists for the plastic deformation of 316 stainless steel.

PHYSICAL PROPERTIES

26071 (BNL—21410) **Studies of the transition temperature and normal state resistivity of Nb_3Ge and Nb films.** Lutz, H.; Weismann, H.; Gurvitch, M.; Goland, A.N.; Kammerer, O.F.; Strongin, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. Contract E(30-1)-16. 15p. (CONF-760464—6). Dep. NTIS $3.50.

From 2. Conference on superconductivity in d- and f-bands; Rochester, New York, United States of America (USA) (30 Apr 1976).

Correlations between T/sub c/ and specific features of the normal state resistance vs temperature curves are discussed for both Nb_3Ge and ion damaged Nb films. Of particular interest is the correlation between T/sub c/ and rho_0 in Nb_3Ge films.

26072 (CONF-760464—2) **Interband scattering contributions to the resistivity of A-15 metals.** Bader, S.D.; Fradin, F.Y. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 24p. Dep. NTIS $3.50.

From 2. Conference on superconductivity in d- and f-bands; Rochester, New York, United States of America (USA) (30 Apr 1976).

The temperature dependence of the resistivity of Nb_3Sn and V_3Si below 50°K in the interband-scattering model is calculated using realistic phonon densities of states, with agreement with experiment. For V_3Si, it is found that phonon-mode shifting is in part responsible for, though not the dominant cause of, the observed negative deviation from linearity of the high-temperature resistivity. Calculations are presented to suggest that this negative deviation from linearity of the high-temperature resistivity is predominantly due to sharp structure in the electronic density of states N(epsilon) near the Fermi energy epsilon/sub F/. It is further argued that the unusually large magnitude of the high-temperature resistivity of Nb_3Sb, a low-T/sub c/ (approximately 0.2 K), low density-of-states A-15 superconductor, is due to thermally accessible structure in N(epsilon) within a characteristic phonon energy from epsilon/sub F/.

26073 (JAERI-M—5829, pp 101-105) **Problems on He bubble diffusion.** Kawasaki, S. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Present situation and problems of measuring the diffusion constant of inert gas in metals are reported. Although the comparison between models and accurate experimental results has to be performed, it is difficult to obtain reliable experimental data because of the driving force of bubbles that causes experimental error. The technical problems of measuring the diffusion of inert gas bubbles in a metal are classified into two methods. One is a method of introducing inert gas into a metal, and the other is a method of measuring the migration velocity of generated bubbles. The former method is not difficult at present because of the development of accelerators, but the latter has problems. There are three methods of measuring the migration of gas bubbles. (1) Measurement of the migration of gas bubbles under no driving force of gas bubbles. (2) Measurement of the bubble migration velocity under known driving force. (3) Determination of bubble diffusion velocity from the frequency of bubble coalescence derived from the change in dimensions of bubbles resulted from initial bubble distribution and heat treatment. Four experiments made by L.E. Willertz et al., G.K. Walker, S.R. Pati et al., and K.Y. Chen et al. are discussed. In case of measuring the gas bubble diffusion, electron microscopes are employed as a rule. The problems of this method are 1) observation of a great many bubbles, 2) visibility of the defects interacting with bubbles due to the diffraction condition of electron beam, 3) employment of thin samples, and 4) driving force of bubbles.

26074 (LBL—4981) **Domain hyperfine fields in some dilute ferromagnetic alloys studied by NMR on oriented nuclei.** Streater, R.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1976. Contract W-7405-Eng-48. 91p. Dep. NTIS $5.00.

Thesis.

Hyperfine field distributions at the sites of ^{60}Co atoms dissolved in some dilute (up to 4 percent) CoFe and NiFe alloys were measured by NMR on oriented nuclei at very low temperatures. The hyperfine field shifts due to neighboring impurities are shown to be consistent with a model in which the shifts are caused by moment perturbations in the neighboring shells surrounding an impurity, with RKKY-like spin density oscillations affecting the conduction electron and core polarization contributions to the hyperfine field. The observed shifts at a ^{60}Co site are +1.86 +- 0.22 kG with a nearest neighbor substituent Co, -4.28 +- 0.17 kG with a second nearest neighbor substituent, -3.41 +- 0.07 kG for a third nearest neighbor substituent and -0.98 +- 0.05 kG for a fourth nearest neighbor substituent. In the NiFe alloys, the shifts are -3.48 +- 0.23 kG, -6.63 +- 0.14 kg, -5.14 +- 0.25 kG, and -1.49 +- 0.14 kG respectively for Ni neighbors. The shifts are shown to be generally smaller than those at the Fe sites, the trends being consistent with a reduced number of itinerant electrons in going across the 3d transition series and with the moment perturbations arising via the itinerant d's. Small quadrupole contributions to the hyperfine interactions are shown to exist by the response in adiabatic fast passage resonance sweeps, but do not contribute significantly to the magnetic resonance lineshapes. ^{60}Co spin-lattice relaxation times were measured for the main and satellite resonances in some CoFe alloys and no statistically significant changes in a function of alloy concentration or the sub-resonance excited were observed.

26075 (ORNL—5131) **Liquid metal fast breeder reactor materials development program. Quarterly progress report for period ending December 31, 1975.** Peterson, S. (comp.). (Oak Ridge National Lab., Tenn. (USA)). May 1976. Contract W-7405-eng-26. 232p. AT.

Activities in research programs are reported on steam generator materials development for CRBR plant, alloy 800 development for LMFBR steam generators, LMFBR structural materials, properties of LMFBR weldments, development of large diameter piping, and advanced absorber materials. (JRD)

26076 (ORNL/TM—4975) **Preparation of ^{147}Pm metal and the determination of the melting point and phase transformation temperatures.** Angelini, P.; Adair, H.L. (Oak Ridge National Lab., Tenn. (USA)). Jul 1976. Contract W-7405-eng-26. 28p. Dep. NTIS $4.00.

The promethium metal used in the determination of the melting point and phase transformation temperatures was prepared by reduction of promethium oxide with thorium metal at 1600°C and distilling the promethium metal into a quartz dome. The melting point and phase transformation temperatures of promethium metal were found to be 1042 +- 5°C and 890 +- 5°C, respectively. The ratio for the heat of the high-temperature transformation to the heat of fusion was determined to be 0.415.

26077 (SAND—76-5289) **Anisotropic conduction-electron exchange in dilute rare earth alloys: NMR in $Au^{173}Yb$ and $La^{31}PCe$.**

Follstaedt, D.M.; Meyer, W.J.; Narath, A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. Contract AT(29-1)-789. 10p. (CONF-760922—2). Dep. NTIS $3.50.

From International conference on magnetism; Amsterdam, Netherlands (6 Sep 1976).

Results of two experiments requiring an anisotropic exchange interaction for their interpretation are reported. Nuclear relaxation rates in $Au^{173}Yb$ at 1.0°K and fields to 120 kOe are shown to arise from local-moment fluctuations within the $GAMMA_7$ ground state, contributions from excited crystal-field levels being unimportant. Nearest-neighbor satellite resonance shifts in LaPCe are not proportional to the Ce^{3+} susceptibility above 26°K.

26078 (SAND—76-5290) **Nuclear-resonance study of local-moment fluctuations in CuMn.** Follstaedt, D.M.; Narath, A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. Contract AT(29-1)-789. 9p. (CONF-760922—6). Dep. NTIS $3.50.

From International conference on magnetism; Amsterdam, Netherlands (6 Sep 1976).

^{63}Cu satellite resonances of host nuclei near Mn impurities were used to probe relaxation of the Mn moment in CuMn. In the range 1.2 to 2.0°K (26 to 50 kOe), the satellite spin-lattice relaxation rates are accounted for using a lowest-order perturbation treatment of the local-moment/conduction-electron exchange interaction with (J^2)/sup 1/2/rho = 0.20(2), in good agreement with the high-temperature (approximately 1200°K) NMR results of Walstedt and Warren.

26079 **Nuclear fuel element.** Grossman, L.N.; Levin, H.A. (to General Electric Co.). Canadian Patent 973644. 26 Aug 1975. 14p.

Available from Commissioner of Patents, Ottawa.

A nuclear fuel element has disposed therein an alloy having the essential components of nickel, titanium and zirconium, and the alloy reacts with water, water vapor and reactive gases at reactor ambient temperatures. The alloy is disposed in the plenum of the fuel element in the form of particles in a hollow gas permeable container having a multiplicity of openings of size smallr than the size of the particles. The container is preferably held in the spring in the plenum of the fuel element.

26080 **Exchange coupling in amorphous rare earth-iron alloys.** Heiman, N.; Lee, K.; Potter, R.I. (IBM Research Lab., San Jose, CA). *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 130-135(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The technologically important amorphous rare earth (RE)-transition metal (TM) alloys provide an excellent system for investigating basic magnetic phenomena in amorphous magnetic materials. The sensitivity of the magnetic properties of the amorphous RE-TM alloys to slight compositional changes indicated the need for a rapid survey of the systematic variation of their properties. A brief review of this survey and the theoretical models is presented. One result is to point out Fe as the most favorable TM for obtaining a more detailed understanding of the magnetic properties. Data are presented from ^{57}Fe Moessbauer effect, magnetometer and magneto-optic measurements on amorphous RE(Gd, Tb, Dy, Ho, Tm, Yb, Lu)-Fe amorphous alloy films. The Moessbauer effect results indicate that the Fe spin decreases with increasing RE content but the rate of decrease is dependent on the RE effective spin, (g - 1)J. A mean field theory model is presented which reasonably reproduces the magnetic properties of the amorphous RE—Fe alloys, and which provides useful insights into their properties. 9 figures, 30 references.

26081 **Magnetic properties of 3d impurities in amorphous Cu—Zr alloys.** Mizoguchi, T.; Kudo, T. (Gakushuin Univ., Tokyo). *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 167-168(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The magnetic susceptibility and electrical resistivity of amorphous (Cu/sub .57/Zr/sub .43/)/sub 1 - x/M/sub x/ alloys, where M expresses 3d transition metal impurities of V, Cr, Mn, Fe, Co and Ni, were measured. The host Cu/sub .57/Zr/sub .43/ alloy shows temperature independent Pauli paramagnetic behavior. The addition of 3d impurities only slightly affects the value of the susceptibility which still remains temperature independent except for Mn, showing that these 3d impurities have no localized magnetic moment in this amorphous alloy. The susceptibility of amorphous Cu—Zr containing Mn can be expressed as the sum of a temperature independent part, and a temperature dependent part which obeys the Curie Weiss law. The effective magnetic moment per Mn atom is about 1.6 μB (gS approximately equal to 1.45 assuming g = 2).

26082 **XPS studies of co-sputtered Gd—Fe alloys.** Guentherodt, G.; Shevchik, N.J. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart). *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 174-175(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The electronic structure of cosputtered Gd/sub x/Fe/sub 1 - x/ alloys (0 less than or equal to x less than or equal to 1) was studied by means of monochromatized x-ray photoemission (XPS). For the amorphous Gd- and Fe-rich compositions, respectively, the conduction band spectra, including the 4 f levels of Gd, are surprisingly very similar to those of crystalline Gd and Fe. These spectra of the alloys appear to be well described as a linear superposition of those of the pure elements. Small Gd yields Fe charge transfer upon alloying is inferred from the unchanged Fe 2p core-level line shape asymmetry and the small shift in energy of the Gd- and Fe-core levels. On the basis of a simple relationship between charge transfer and altered interatomic separation distances, the charge transfer in the amorphous alloys appears to be too small, compared to the crystalline phases, in order to account for the magnitude of the Fe moment.

26083 **Magnetic resonances in a-$TbFe_2$, a-$GdFe_2$ and a-YFe_2.** Bhagat, S.M.; Paul, D.K. (Univ. of Maryland, College Park). *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 176-177(1976).

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The resonance microwave absorption in amorphous $TbFe_2$, $GdFe_2$, and YFe_2 was investigated at several frequencies and temperatures. The resonances showing a four-line (S_1 through S_4) spectra, though somewhat similar in all three systems, have many puzzling features. The strong resonance (S_1) represents the usual q approximately equal to 0 mode maintained by thermally activated magnon hopping among clusters whose local magnetization is close to the saturation magnetization, M/sub s/. The S_4-line, however, appears to have much weaker magnetization, and has been assigned to localized magnon mode. A preliminary discussion of the data is presented in terms of a spin-cluster model.

26084 **FMR in some amorphous RE—3-d transition metal films.** Lubitz, P. (Naval Research Lab., Washington, DC); Schelleng, J.; Vittoria, C.; Lee, K. *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 178-179(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Ferrimagnetic resonance (FMR) and vibrating sample magnetometer (VSM) measurements were made on amorphous $GdCo_3$ and Gd-, Ho-, Tb- and $DyFe_2$ for temperatures from 90 to 500°K. For Gd alloys, the T dependence of the line-width is in general agreement with that predicted for a T independent Landau-Lifshitz damping parameter of approximately 10^8/s. Ho- and $TbFe_2$ have progressively broader resonances indicating an increase in both intrinsic damping and inhomogeneous broadening. Dy- and $HoFe_2$ and to a lesser degree the Gd alloys show inconsistencies between the FMR and VSM values for the magnetization.

26085 **Curie temperatures of amorphous RFe_2 alloys.** Rhyne, J.J. (National Bureau of Standards, Washington, DC). *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 182-183(1976).

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See CONF-751209—.

Curie temperatures of the series of amorphous rare earth-iron alloys RFe_2 (where R = Gd, Tb, Dy, Ho, Er, and Y) have been determined from Belov-Goryaga plots of the magnetization isotherms. The Curie temperature of $GdFe_2$ is 500°K, and drops sharply (e.g. $ErFe_2$ T/sub c/ = 105°K) as one proceeds to the right in the above series (decreasing R spin). The observed Curie temperatures exhibit a smooth variation with the DeGennes factor of the rare earth ion, with the zero spin limit YFe_2 exhibiting no long-range order. This is in marked contrast to the analogous crystalline Laves phase compounds for which YFe_2 has a 535°K Curie temperature and which show a much weaker dependence on the rare earth spin. These results imply a more significant effect of the structural disorder on the direct Fe—Fe exchange versus the RKKY Fe—R and R—R couplings. A molecular field model describing these interactions has been used to calculate the expected Curie temperature for both the amorphous and crystalline series. Overall agreement with the observed T/sub c/'s was less satisfactory for the amorphous than for the crystalline materials.

26086 **Pressure dependence of magnetic properties of amorphous RE-TM thin films.** Biesterbos, J.W.M.; Brouha, M.; Dirks, A.G. (Philips Research Labs., Eindhoven, Netherlands). *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 184-185(1976).

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See CONF-751209—.

The pressure dependence of the Curie temperature of various amorphous RE—TM alloys (prepared by electron beam coevaporation), having 100 less than T/sub c/ less than 400°K, was measured. In all cases relatively large negative dT/sub c//dP values were found, similar to those for crystalline RE—TM intermetallic compounds. This implies that the lower T/sub c/ of the amorphous alloys (20 to 300°K lower than of the corresponding crystalline phases) cannot be simply ascribed to the lower densities of the amorphous alloys. Like found previously for the crystalline compounds, the dT/sub c//dP values for the amorphous RE—TM alloys agree qualitatively with the itinerant model of band ferromagnetism.

26087 Magnetic properties of bulk amorphous Tb/sub x/Fe/sub 1-x/. Alperin, H.A. (National Bureau of Standards, Washington, DC); Cullen, J.R.; Clark, A.E. *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 186-187(1976).

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See CONF-751209—.

Magnetization measurements were made on four bulk samples (compositions x = .018, .118, .167 and .25) prepared by direct current rapid sputtering. Neutron diffraction measurements show these samples to be amorphous. All four samples are ferrimagnetic; however, the 17 percent sample is almost completely compensated at temperatures below 100°K. With decreasing Tb-content, the Curie temperatures fall from a maximum of 405°K for x = .25 to the value of 245K for x = .018. Anomalously large coercive fields and time dependent megnetizations are present at low temperatures.

26088 Rhombohedral distortion in highly magnetostrictive Laves phase compounds. Clark, A.E. (Naval Surface Weapons Center, White Oak, MD); Cullen, J.R.; McMasters, O.D.; Callen, E.R. *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 192-193(1976).

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A model is presented which produced a magnetostrictively driven rhombohedral distortion ($lambda_{111}$) in cubic diamond-like structures. No tetragonal magnetostrictive distortion ($lambda_{100}$) is allowed, which is consistent with the experimental observations, $lambda_{111}$ much greater than $lambda_{100}$. From x-ray and single crystal measurements we find parallel $lambda_{111}/lambda_{100}$ parallel greater than 600 for $DyFe_2$. Rhombohedral distortions ($lambda_{111}$) are examined in the ternary Tb/sub 1 - x/Gd/sub x/Fe_2, Tb/sub 1 - x/Y/sub x/Fe_2 and Tb/sub 1 - x/Dy/sub x/Fe_2 systems by x-ray methods. The single-ion nature of the giant Tb magnetostriction in $TbFe_2$ is verified.

26089 Moessbauer and magnetization study of Tb(Fe/sub 1-x/Al/sub x/)$_2$. Preston, R.S.; Taneja, S.P.; Drensky, S.M.; Dwight, A.E.; Kimball, C.W.; Sill, L.R. (Northern Illinois Univ., DeKalb). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 194-195(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The magnetization and magnetic hyperfine field at ^{57}Fe nuclei have been measured in Tb(Fe/sub 1 - x/Al/sub x/)$_2$ Laves phase alloys to examine possible correlations of the magnetic properties with the concentration dependence of the rhombohedral distortion. The magnetic moment per molecule at 300°K is almost constant for all concentrations for which the crystal is distorted (x less than 0.24); the saturation moment at 300°K then begins to decrease smoothly. The maximum magnetic hyperfine field also varies smoothly over the concentration range which spans the onset of detectable distortion. We conclude that in this concentration range there are no real anomalies in the lattice magnetization nor in the magnetizations of either of the two oppositely magnetized sublattices.

26090 Magnetic properties of Gd/sub 1-x/Fe/sub x/ films. Vittoria, C.; Lubitz, P.; Schelleng, J. (Naval Research Lab., Washington, DC). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 196-197(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The saturation magnetization, M, g-value, exchange and magnetic damping parameter were measured in films of Gd/sub 1 - x/Fe/sub x/, where 0 less than x less than 1, as a function of temperature and frequency using ferromagnetic resonance (FMR) and vibrating sample magnetometer techniques. We find for x approximately .9 that the dominant exchange coupling is between the Fe—Fe ions. The exchange-conductivity linewidth broadening mechanism is minimal in this system.

26091 Crystal field in liquid cerium and praseodymium. Millhouse, A.H.; Furrer, A. (Institut fuer Reaktortechnik, Wuerenlingen, Switzerland). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 257-258(1976).

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By means of inelastic neutron scattering experiments on liquid La, Ce, and Pr it is demonstrated that a well defined local crystal field of uniaxial symmetry exists in liquid rare earths. The results indicate that the effective charge distribution in liquid rare earth metals is independent of the particular rare earth element.

26092 Ground- and excited-state spin waves in $PrAl_2$. Purwins, H.G. (Univ., Geneva); Buyers, W.J.L.; Holden, T.M.; Svensson, E.C. *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 259-260(1976).

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The magnetic excitations in ferromagnetic $PrAl_2$ were studied by means of neutron inelastic scattering. Branches of excitations corresponding to four of the six allowed magnetic-dipole transitions have been observed. At the magnetic zone boundary, where the excitation spectrum most closely approximates a single-ion spectrum, the observed frequencies are 1.54 +- 0.04, 2.05 +- 0.05 and 3.76 +- 0.06 THz. The results are analyzed in terms of exchange and crystal-field parameters using the pseudoboson theory for all states of the J = 4 manifold. The crystal-field-only ground state is found to be a non-magnetic doublet but the exchange interaction is strong enough to induce almost the full moment at low temperatures. At elevated temperatures in the ordered phase, excited-state spin waves have been observed at 0.55 +- 0.10 THz. These correspond to a transition between the upper member of the exchange-split ground doublet, and the second member of the exchange-split triplet state.

26093 Application of standard-basis operators to the theory of electronic and magnetic properties of actinide compounds. Robinson, J.M. (Indiana—Purdue Univ., Fort Wayne). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 319-320(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The electronic energy bands of a cubic metallic crystal were derived, starting from localized s (or d) and f orbitals in Hubbard's atomic representation. The standard-basis operator technique of Haley and Erdos is applied to this model and leads to electronic and magnetic properties intermediate between those of the localized and band descriptions. The paramagnetic susceptibility and s-f hybridization follow the Curie-Weiss law at high temperatures and level off with decreasing temperature. These results agree qualitatively with the behavior observed in many actinide intermetallic compounds, as does also a simple calculation of the electrical resistivity of the model.

26094 Superconducting and magnetic properties of V/sub 3-x/Fe/sub x/Si and V/sub 3-x/Mn/sub x/Si. Bergner, R.L.; Rao, V.U.S.; Sankar, S.G. (Univ. of Pittsburgh). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 325-326(1976).

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See CONF-751209—.

The superconducting, magnetic and structural properties of intermetallic compounds V/sub 3 - x/Fe/sub x/Si and V/sub 3 - x/Mn/sub x/Si were investigated. The crystal strucure is of the β-W type up to about x = 0.5 in both systems, with the lattice parameter decreasing with increasing x. The superconducting transition temperature, T/sub S/, and the upper critical field, H/sub c2/, were determined from resistivity measurements. For x = 0.015 in V/sub 3 - x/Fe/sub x/Si, H/sub c2/ was enhanced over that of V_3Si. However, no such enhancement was found upon addition of Mn impurities to V_3Si. Susceptibility measurements indicate a local moment on Fe in V/sub 3 - x/Fe/sub x/Si with μ/sub eff/ approximately 1.2 μ/sub B/. No detectable moment was associated with Mn in V/sub 3 - x/Mn/sub x/Si. These results indicate an antiferromagnetic coupling between Fe and conduction electron spins. On the Fe-rich side (x = 2.0 to 3.0), the crystal structure was of the cubic BiF_3 type. In this region the Curie temperature decreased with increasing vanadium content.

26095 Magnetic properties of $ScFe_2$. Sankar, S.G.; Wallace, W.E. (Univ. of Pittsburgh). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 334(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

$ScFe_2$ crystallizes in the hexagonal C-14 Laves phase. Magnetic measurements performed in the temperature range 4 to 600°K reveal that the sample orders ferromagnetically with a Curie temperature of 545°K. Saturation magnetization measurements performed at 4.2°K yield a value of 2.9 μ/sub B/ per formula unit of $ScFe_2$. The easy axis of magnetization was determined by examining the changes in the intensities of x-ray pattern on aligning a powder at room temperature in a field of 20 kOe. This was found to be along the c-axis. Moessbauer pattern at room temperature exhibits a magnetic hyperfine interaction with a complex spectrum.

26096 Determination of the energy level parameters and crystal field splitting for Fe in Cu. Boyce, J.B. (Xerox Palo Alto Research Center, CA); Slichter, C.P. *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 335-336(1976).

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See CONF-751209—.

Values for the Friedel-Anderson energy level parameters for Fe in Cu have been obtained using the measured conduction electron spin density around the Fe impurity. The expression for the spin density due to Jena and Geldart was applied to the NMR data on the spectral shifts of the Cu near neighbor resonances. A good explanation for this data could not be obtained unless the crystal field splitting of the Fe d-levels was taken into account. Direct experimental evidence for such a non-negligible crystal field splitting has been obtained in the single crystal NMR studies of T. Stakelon. The energy level paramters we obtain are: t - e crystal field splitting, $\Delta = 0.5$eV; virtual level width, GAMMA/sub d/ = 0.7 eV; Coulomb splitting of spin-up and spin-down virtual levels, U = 5.6 eV. These results are consistent with CuFe being magnetic in the Anderson sense (U/GAMMA/sub d/ = 8 greater than 1) and yield, via the Friedel sum rule, a total of seven d-electrons with a net spin of 1.25.

26097 Hyperfine fields in the absence of magnetic order in Dy—Sc alloys. Abbundi, R. (American Univ., Washington, DC); Segnan, R.; Rhyne, J.J.; Sweger, D.M. *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 352-353(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Tb/sub x/Sc/sub 1 - x/ and Gd/sub x/Sc/sub 1 - x/ alloys have been shown to exhibit no long-range magnetic order for x less than .25 (in Tb—Sc) from neutron scattering and magnetization experiments in contrast to Y based alloys and conventional theory which predicts a vanishing of T/sub N/ only as x yields 0. The Dy hyperfine fields were investigated in a series of Dy/sub x/Sc/sub 1 - x/ alloys in a similar range in which no T/sub N/ is found (above 4K). Although no long-range order is present, the alloys do show a well-defined hyperfine splitting corresponding to a field approximately equal to that in pure Dy metal and independent of Dy concentration. This is present even in a 2 percent Dy alloy which is the lowest concentration measured. This surprising result suggests a spin-relaxation mechanism is operative which produces the observed hyperfine fields, but which is not accompanied by static long-range magnetic order.

26098 Kondo resistivity in the singlet ground state system La/sub 1-x/Pr/sub x/Sn_3. Abou-Aly, A.I.; Bakanowski, S.; Berk, N.F.; Crow, J.E.; Mihalisin, T. (Temple Univ., Philadelphia). *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 358-360(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

A minimum followed by a maximum was observed in the resistivity of the singlet ground state system La/sub 1 - x/Pr/sub x/Sn_3. In sufficiently dilute samples (x less than .2), resistivity, magneto-resistance and magnetization measurements indicate that this striking resistance behavior is not attributable to magnetic ordering. Also, this local maximum in the magnetic contribution to the resistivity cannot be explained by a first Born approximation calculation of the inelastic scattering from the crystalline electric field (CEF) levels. The observed behavior is strongly suggestive of "Kondo" scattering from the excited magnetic CEF levels followed by a precipitative drop in the resistivity ascribable to the thermal deactivation of the excited CEF levels.

26099 Magnetic field dependence of the specific heat of PdDy alloys. Zweers, H.A. (Univ., Leiden); Nieuwenhuys, G.J.; van der Linden, H.W.M.; Mydosh, J.A. *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 368-369(1976).

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See CONF-751209—.

The specific heat of PdDy alloys between 1.2 and 20 K in external fields ranging from 0 to 20 kOe was measured. The data are analyzed with respect to the crystal field splitting CFS of the Dy-ion in a cubic symmetry. Previously, different crystal field level schemes had been proposed for this system based upon the interpretation of EPR, magnetization and specific heat measurements. The application of a straightforward CFS analysis still shows systematic deviations from our experimental data. Some different CFS possibilities are presented here, which, when combined with a weak internal field, form a reasonable description for the specific heat data.

26100 Model for magnetic properties of Pd(Gd) alloys. Praddaude, H.C. (Massachusetts Inst. of Tech., Cambridge); Foner, S.; McNiff, E.J. Jr.; Guertin, R.P. *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 370-371(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

A model is presented which describes the paramagnetic properties of polycrystalline Pd/sub 1 - x/Gd/sub x/ alloys for 0.0003 less than or equal to x less than or equal to 0.02, 3 kG less than or equal to H less than or equal to 215 kG and 1.3 K less than or equal to T less than or equal to 4.2 K. The effective field acting on the Gd is the resultant of the applied field plus an anisotropy field which is postulated to be transverse to the external field. This transverse field is responsible for the slow approach to magnetic saturation. The fit of the magnetic data to this model yields a saturation magnetization of 7 μ/sub B//Gd-atom (equal to the Gd^{3+} free ion value) for all concentrations.

26101 Electronic moments induced by nuclear moments in Van Vleck compounds. Genicon, J.L.; Tournier, R. (CNRS, Grenoble, France). *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 422-423(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The nuclear magnetization of several Van-Vleck compounds of praseodymium at low temperatures and in high magnetic fields was measured. In the (Pr/sub x/La/sub 1 - x/) Sn_3 system, saturation of the nuclear magnetization was reached. This saturation value decreases with increasing field. To account for this behavior, a simple "nuclear field" model was proposed. This model can also be used for simple systems such as $PrIn_3$ or for intermediate cases such as $PrCu_6$.

26102 Crystal electric field effects on the transport properties of intermetallic rare earth systems. Wong, Y.H.; Luthi, B. (Rutgers-the State Univ., New Brunswick NJ). *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 534-535(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Measurements at low temperatures (1.5 to 11K) of the electrical resistivity and thermal conductivity of pnictide compounds LnSb (Ln = La, Er, Tm) are reported as well as the induced moment system $PrCu_5$. The anomalous temperature dependence of these transport properties provide strong evidence of an increased scattering of the carriers through exchange and aspherical Coulomb interaction with the localized 4f electrons.

26103 Magnetic behavior of some rare earth germanides of the type RGe_2Fe_2. Malik, S.K. (Univ. of Pittsburgh); Sankar, S.G.; Rao, V.U.S.; Obermeyer, R. *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 585-586(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Magnetic properties of tetragonal rare earth germanides of the type RFe_2Ge_2, where R = Pr, Gd, Tb, Er and Th, were investigated in the temperature interval 4.2 to 273 K and in magnetic fields up to 20 kOe. The magnetization of $ThFe_2Ge_2$ is small and weakly temperature dependent. The compounds with Pr, Gd and Tb show antiferromagnetic ordering with Neel temperature of 14°K, 11°K and 7.5°K, respectively. The Pr sublattice in $PrFe_2Ge_2$ and the Tb sublattice in $TbFe_2Ge_2$ both undergo a transition, which at 4.2°K occurs at a field strength of about 15 kOe. The Gd compound does not show a transition up to a field of 20 kOe. The compound $ErFe_2Ge_2$ is paramagnetic in the temperature range investigated. However, some magnetization from Fe sublattice seems to be present in all the compounds.

26104 High field magnetization studies on Y/sub 1-x/Th/sub x/Fe_3 compounds. Narasimhan, K.S.V.L.; Butera, R.A.; Kunesh, C.J. (Univ. of Pittsburgh). *AIP* (*Am. Inst. Phys.*) *Conf. Proc.*; No. 29, 588-590(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Saturation magnetization measurements were made on Y/sub 1 - x/Th/sub x/Fe_3 compounds up to a field of 120 kOe. The moment decreases linearly with x. The results on fine particles of $Y_{0.1}Th_{0.9}Fe_3$ indicate that the anomaly observed in this material does not arise due to the magnetic anisotropy.

26105 Magnetic properties of RMn_2X_2 compounds (R=rare earth, Y or Th and X=Ge, Si). Narasimhan, K.S.V.L. (Univ. of Pittsburgh); Rao, V.U.S.; Wallace, W.E.; Pop, I. *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 594-595(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Magnetic properties of RMn_2Ge_2 and RMn_2Si_2 compounds crystallizing in the $BaAl_4$ type structure were investigated over a wide temperature range (4.2°K to 1200°K). $LaMn_2Ge_2$, $CeMn_2Ge_2$, $PrMn_2Ge_2$ $NdMn_2Ge_2$ and $LaMn_2Si_2$ all possess Curie temperatures above 300°K and the easy direction of magnetization have been found to be along the c-axis. When R is a heavy rare earth antiferromagnetic coupling was obtained at 4.2°K between the rare earth and manganese moments whereas when R is a light rare earth a ferromagnetic coupling of moments was obtained. YMn_2Si_2, $ThMn_2Si_2$, and $ThMn_2Ge_2$ possess a small moment less than .2μ/sub B/ at 4.2°K. High temperature susceptibilities on RMn_2Si_2 compounds indicate a Curie—Weiss behavior.

26106 Precipitation hardened RE—Co-magnets. Menth, A. (Brown Boveri Research Center, Baden, Switzerland). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 600-602(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Magnetic and metallographic investigations are reported on Sm(Co,Cu)/sub z/ with 5 less than or equal to z less than 8.5 and Cu-contents up to 35 percent of the transition metal fraction. The as-cast as well as the heat treated materials were evaluated. Two typical compositions $Sm(Co_{0.65}Cu_{0.35})_{5.6}$ as an example of a single phase 1:5 type magnet material and $Sm(Co_{0.84}Cu_{0.16})_{8.9}$ as an example of a two phase magnet material, namely a primary 2:17 phase in a 1:5 type matrix, are considered in detail. Both materials produced, after an appropriate high temperature annealing, rectangular ideal demagnetization curves, implying that the macroscopic 2:17 primary phase is magnetically hard. Low temperature heat treatments resulted in two maxima in the coercivity /sub I/H/sub C/ as a function of T. The data are discussed based on metallurgical investigations of the phase diagrams and electron microscopy results.

26107 Magnetic properties of sintered Sm_2TM_{17} magnets. Nagel, H. (Brown Boveri Research Center, Baden, Switzerland). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 603-604(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Sm_2TM_{17} magnets were produced by powder metallurgical techniques, with TM standing for combinations of 3d transition metals. The compositional dependence as well as the influence of the different process parameters, as for instance particle size and sintering temperature, have been investigated. The maximum hard magnetic values obtained so far are a magnetic remanence of 11.3 kG and a coercivity field of 11 kOe. However, maximum B/sub R/ and /sub I/H/sub c/ could not be obtained simultaneously so far. All the magnets present demagnetization curves typical for a chemically and structurally homogeneous composition of the material. The hard magnetic properties observed are discussed with respect to the primary magnetic properties.

26108 Magnetocrystalline anisotropy of compounds with compositions near Gd_2Co_{17}. Katayama, T.; Koizumi, Y.; Kawanishi, K.; Shibata, T.; Tsushima, T. (Electrotechnical Lab., Tokyo). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 606-607(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The magnetocrystalline anisotropy of Gd—Co phases in the stable region of the Th_2Zn_{17}-type structure changes very sensitively from negative to positive as Gd/Co increases above the stoichiometric ratio. Magnetic properties of single crystals with the compositions of Gd_2Co_{17} and $Gd_{2.1}Co_{16.8}$ were measured. K_1 and K_2 of Gd_2Co_{17} at room temperature are -2.7 x 10^6 and +2.5 x 10^5 erg/cm^3, respectively. While, K_1 and K_2 of $Gd_{2.1}Co_{16.8}$ at the same temperature are 3.0 x 10^6 and 4.7 x 10^5 erg/cm^3, respectively. This change of anisotropy is discussed in terms of the crystalline field around Gd and Co sites.

26109 High field magnetic measurements on sintered $SmCo_5$ permanent magnets. Trout, S.R.; Graham, C.D. Jr. (Univ. of Pennsylvania, Philadelphia). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 608-609(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Hysteresis loops in fields to 100 kOe have been measured at 300, 77, and 4.2°K parallel and perpendicular to the alignment axis in a series of sintered $SmCo_5$ magnets with compositions varying from 16.24 to 17.08 at. percent Sm. Analysis of the data taken perpendicular to the alignment axis permits evaluation of the effective anisotropy constant K_1, and also the degree of misorientation of the individual particles. Intrinsic coercive fields H/sub ci/ varied from 0.34 to 16.4 kOe at room temperature. In all samples, H/sub ci/ and K_1 increased rapidly with decreasing temperature, roughly doubling between room temperature and 77°K. The values of H/sub ci/ and (BH)/sub max/ depend strongly on composition, but the anisotropy does not. Variations in permanent magnet properties are therefore not directly related to variations in the bulk anisotropy.

26110 Upon influencing the magnetocrystalline anisotropy of RE_2TM_{17} compounds. Perkins, R.S.; Straessler, S.; Menth, A. (Brown Boveri Research Center, Baden, Switzerland). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 610-612(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

A simplified form of the theoretical single-ion, crystal field contribution to the magnetocrystalline anisotropy of RE_2TM_{17} compounds is given. Through an evaluation of this contribution in Sm_2(Co/sub 1 - x/Fe/sub x/)$_{17}$ compounds, two methods of favorably altering their anisotropy were suggested. The first involves substitution of Sm by Tb in order to compensate the adverse influence of Fe beyond x approximately equal to 0.2. The expected effect is observed. Substitution of Co by Mn or Cr was used in an attempt to avoid the consequences of structural features of the Fe-containing alloys upon the anisotropy. These new compounds yield up to 40 percent improvement in the anisotropy, and at higher magnetizations, compared to Sm_2Co_{17}.

26111 Orientation and remanent magnetization of $SmCo_5$ magnets. Swift, W.M.; Reynolds, W.T.; Schrecengost, R.M.; Ratnam, D.V. (Westinghouse Research Labs., Pittsburgh). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 612-613(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The Schulz x-ray method of planar orientations was used to characterize the statistical distribution of (0001) plane orientations for five $SmCo_5$ magnets having energy products in the range 4.5 to 19 MGOe. X-ray intensity data were used to calculate the volume fraction of grains having their (0001) planes located in eighteen equiarea polar intervals defined by α, the tilt angle of the (0001) plane with respect to the sample plane, and phi, the azimuth angle defined from an arbitrary direction in the sample plane. From these data and assumptions about magnetization reversal, calculations of remanent magnetizations and energy products were made.

26112 Narrow Bloch walls in RCo_5-type rare earth cobalt compounds. Buschow, K.H.J.; Brouha, M. (Philips Research Labs., Eindhoven, Netherlands). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 618-619(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The magnetic isotherms of various compounds of the type RCo_5 in which Co is partially replaced by either Cu or Ni were studied at 4.2°K as a function of Co concentration. The form of the virgin magnetization curve, the presence of large intrinsic coercive forces, and the observation of pronounced thermomagnetic history effects indicate the presence of Bloch walls in these compounds having a width of only a few interatomic distances. It is argued that the presence of these narrow Bloch walls is the primary reason for the high coercive forces observed usually in solid pieces of materials of the type RCo/sub 5x/Cu/sub 5 - 5x/.

26113 Magnetic resonance of Gd in $LaNi_5$ and $LaNi_5$ hydride. Walsh, W.M. Jr.; Rupp, L.W. Jr.; Schmidt, P.H.; Longinoitti, L.D. (Bell Labs., Murray Hill, NJ). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 686-687(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The influence of hydrogen uptake on the magnetic properties of $LaNi_5$ has been investigated by observing the electron spin

resonance of small amounts of Gd substituted for La. Hydrogenation causes a large exchange induced g-shift to decrease very strongly in magnitude and to reverse sign. Only ESR signals corresponding to the unhydrided or fully hydrided states are observed, indicating very little range of solid solution. These results are similar to the cases of ESR of Gd and Mn in the Pd, H system but some distinctions are drawn. In particular appreciable microwave loss in fully hydrided $LaNi_5$ shows it to be only weakly conducting rather than metallic. Repeated hydrogenation cycles produce an increasingly intense ferromagnetic resonance signal suggesting precipitation of metallic Ni.

26114 Preparation of Nb_3Ge by chemical vapor deposition. Braginski, A.I.; Roland, G.W.; Daniel, M.R. (Westinghouse Research Labs., Pittsburgh). *Appl. Polym. Symp.;* No. 29, 93-104(1976).

From Conference on new and specialty fibers; Chicago, IL, USA (26 Aug 1975).

Superconducting Nb_3Ge tape fabrication by chemical vapor deposition (CVD) and the relevant material properties were investigated. The known phases in the Nb—Ge system are reviewed and a new tetragonal phase coexisting with the A-15 superconducting phase is reported. High superconducting transition temperatures, T/sub c/, observed in Ge-deficient samples are tentatively explained by the A-15 phase inhomogeneity. Critical current densities of high-T/sub c/ samples measured in low and high magnetic fields confirm the technological potential of CVD-grown Nb_3Ge.

26115 Alternating current permeability of defect-free type-II superconductors. Clem, J.R.; Kerchner, H.R.; Sekula, S.T. (Ames Laboratory—ERDA and Department of Physics, Iowa State University, Ames, Iowa 50010). *Phys. Rev., B;* **14**: No. 5, 1893-1901(1 Sep 1976).

A theoretical and experimental study is presented of ac losses in the mixed state of type-II superconductors when viscous damping dominates flux line motion. The theory describes the ac response of a cylindrical superconductor in the mixed state in a dc magnetic field H and a superposed parallel ac field of arbitrary frequency. The complex ac permeability is found to be related to the flux-flow resistivity rho/sub f/(B), the differential permeability μ' (B) = dB/dH, the frequency, and the sample radius. Measurements were made of the ac permeability in the frequency range 45—1000 Hz of two NbTa alloys which were prepared to minimize bulk-pinning and surface losses. Values of rho/sub f/(B) and μ' (B) derived from the measurements agree qualitatively with the model, but rho/sub f/(B) shows a weak frequency dependence that may arise from the presence of remnant nonviscous losses. (AIP)

26116 Thermomechanical heat generation in copper and a Nb-Ti superconducting composite. Easton, D.S.; Kroeger, D.M.; Moazed, A. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Appl. Phys. Lett.;* **29**: No. 6, 382-384(15 Sep 1976).

Heat generation via tensile stresses in both pure copper and a superconducting Nb-Ti composite was studied at 300 and 4.2 K. Linear thermoelastic behavior was found at room temperature but not at 4.2 K. At 4.2 K, stress levels on the order of 88 MPa and 0.1% strain produced energy losses of 1 to 2 x 10^5 J/m³. When stress cycled under adiabatic conditions, the composite showed a temperature increase with each cycle as a result of nonlinear (hysteretic) stress/strain behavior. (AIP)

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 25732, 25764, 25765, 25852

26117 (ANCR—1311) **Burst testing of alloys 800 and 310 at 1,255 K (1,800°F) with a simulated coal gasification atmosphere.** Dixon, C.E. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office). May 1976. Contract E(10-1)-1375. 49p. Dep. NTIS $4.50.

Several corrosion- and heat-resistant alloys are being considered for long term applications in coal gasification plants at temperatures up to 1.255°K in high pressure environments of mixed hydrogen, water, hydrocarbons, and sulfides. A method for in situ testing has been developed for short time mechanical tests of candidate alloys in high pressure, high temperature, gaseous environments, referred to as coal gasification atmosphere (CGA). The method involves bursting thin-walled tubes, using various gases to produce the burst hoop stress. The short time 1.255°K burst and creep rupture strength and ductility properties of alloys 800 and 800H in a mixed gas environment, H_2, CO, CO_2, CH_4, SO_2 (CGA), are not reduced from properties obtained in air. However, the stress- and pressure-accelerated corrosion is more severe in CGA. It is expected that CGA will reduce long term strength and ductility in alloy 800 as a result of the accelerated corrosion. The short time 1.255°K strengths of alloy 310 in CGA and pure hydrogen environments are reduced from the values obtained in air by less than 10 percent. The ductilities (total circumferential elongation) are good—approximately 20 percent for all test conditions. The CGA stress- and pressure-accelerated corrosion is greater than in air. Longer time tests in CGA are expected to result in additional strength degradation. Limited creep/fatigue tests of alloy 310 in hydrogen show that hold times are significant. A greater cyclic life is observed using an 8-second hold time than a 55-second hold time.

26118 (BNL-NUREG—50517) **Intergranular stress corrosion cracking of sensitized stainless steels. Third quarterly progress report, January 1—March 31, 1976.** (Brookhaven National Lab., Upton, N.Y. (USA)). Jun 1976. Contract E(30-1)-16. 13p. Dep. NTIS $3.50.

The electrochemical scanning device was modified and preliminary tests carried out to demonstrate its applicability to integranular attack studies. These tests demonstrated that it is possible to identify the electrochemical currents originating from grain boundary attack on sensitized stainless steels. However, the currents are quite small under the conditions of the experiments, so improvements are needed. The device can only be used to study intergranular attack of coarse-grained material. Work on the effect of the grain size on the sensitization and corrosion was initiated and the results discussed. (DLC)

26119 (JAERI-M—6181) **Zircaloy-steam reaction under a simulated loss-of-coolant accident.** Kawasaki, S.; Furuta, T.; Hashimoto, M. (Japan Atomic Energy Research Inst., Tokyo). Jul 1975. 14p. (In Japanese). INIS.

Under a simulated loss-of-coolant condition, the reaction between zircaloy and steam and the embrittlement of the zircaloy oxidized by this reaction have been studied. The parabolic rate constant, ksub(p), in the zircaloy-steam reaction is represented as ksub(p)=3.24x10^6 exp¹(−40500/RT)(mg²/cm⁴. sec) Ring compression test was made on the steam-reacted zircaloy tubes, and following results were obtained: Embrittlement of the steam-reacted zircaloy tube increases with oxidation at each oxidation temperature. For a given quantity of the oxidation, the incursion of α-phase into β-phase is more remarkable in the specimens reacted at low temperatures than those at high temperatures. The embrittlement, however, is larger in the specimens oxidized at high temperatures than those at low temperatures.

26120 (JAERI-M—6182) **Effect of oxygen content and distribution on embrittlement of the zircaloy cladding.** Furuta, T.; Hashimoto, M.; Kawasaki, S. (Japan Atomic Energy Research Inst., Tokyo). Jul 1975. 20p. (In Japanese). INIS.

Embrittlement of the zircaloy cladding in a loss-of-coolant accident is related with the oxygen content caused by zircaloy-steam reaction. The effects of oxygen content and its distribution on embrittlement of the zircaloy cladding have been studied to provide more realistic fuel-rod evaluation in such an accident. Zircaloy-4 specimens of five different oxygen contents up to 11700 ppm were prepared at 800°C in an oxygen atmosphere; and the oxygen distribution in each specimen was varied by heating at 850°C in a vacuum for different durations up to 360 hours. Hardness test, microstructural observation and oxygen analysis by X-ray microprobe analyzer were performed. The deformation in ring compression test was measured at 100,300,500 and 700°C. The following results were revealed: (1) Growth of the crystal grains in the oxygen-enriched specimens corresponds with the extent of oxygen diffusion. (2) A ductility minimum appears for the specimens containing 3000 ppm of oxygen at 100°C. It occurs for the specimens containing over 5300 ppm of oxygen at 300°C and 11700 ppm at 500°C.

26121 (SVF—24) **Filterability of corrosion products formed between carbon steel and water. Influence of temperature and oxygen content.** Kelen, T.; Falk, I. (Stiftelsen foer Vaermeteknisk Forskning, Studsvik (Sweden)). Sep 1975. 38p. INIS.

Revised and translated edition of SVF—12.

A laboratory investigation has been made for the purpose of studying the influence of temperature and oxygen content on the filterability of corrosion products formed between carbon-steel and water. The experiments were performed in a high temperature loop where the water is initially heated in a pre-heater, then cooled and finally filtered. The corrosion products were transferred to the water from a carbon-steel surface that had previously been neutron activated and the amount of iron present was determined from measurements of the γ-radiation emitted by Fe-59. Filterability was then computed as the ratio between the total amount of iron in the water phase and the amount of iron retained on the filter. The investigation covers a series of experiments at filtering temperatures of 20, 90 and 160 dec G, pre-heater temperatures up to 300 deg C and oxygen contents of 10 and 300 ppb O_2. In addi-

tion the extent of iron deposition in the pre-heater and heat regulator has been determined after each series of experiments. Filterability exhibited a pronounced dependence upon both the filter and pre-heater temperatures and also upon the oxygen content. Among the conclusions to which the results lead is the observation that a strict comparison of filterability values for the fraction of corrosion products in cooled water samples is impossible when these are taken from 1) different sections of a high temperature system 2) a single sampling point while the system is being run up 3) two separate systems (e.g. steam boilers) operated at different temperatures 4) two separate systems operated at different oxygen contents. It accordingly appears advizable to restrict the use of cold-filtered samples from conventional steam-raising plants to the comparison of values relating to a single sampling point under constant operating conditions.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 26075, 26364, 26905, 26911

26122 (CONF-760515—3) **Effects of interstitial solutes on the microstructures of self-ion irradiated vanadium.** Agarwal, S.C.; Potter, D.I.; Taylor, A. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 20p. Dep. NTIS $3.50.

From 8. symposium of the American Society for Testing and Materials on the effect of radiation on structural materials; St. Louis, Missouri, United States of America (USA) (4 May 1976).

Vanadium and vanadium containing 0.1 percent C, 0.4 percent C, 1.0 percent N, and 1.0 percent O were irradiated with 3-MeV $^{51}V^{+}$ ions in the temperature range 650 to 880°C to a dose level of approximately 20 dpa. The results show that nitrogen is most effective in controlling the void swelling. Carbon and oxygen also suppress the swelling considerably when compared with unalloyed vanadium. Except for V-1.0 percent N, all compositions exhibit a fine platelet precipitate with (012) habit at 650°C. In the case of vanadium-carbon alloys, this phase persisted even at higher temperatures. Vanadium and V-1.0 percent O showed fine precipitation on dislocations and void surfaces at 880°C. V-0.1 percent C exhibited a metastable (013) carbide precipitate at 880°C, whereas V-0.4 percent C showed equilibrium V_2C phase with some (012) precipitates. This (012) precipitation was irradiation induced and was dependent upon the carbon concentration. V-1.0 percent N did not show any evidence of precipitation over the entire temperature range.

26123 (CONF-760530—2) **In-reactor deformation of solution annealed type 304L stainless steel.** Flinn, J.E.; McVay, G.L.; Walters, L.C. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 38p. Dep. NTIS $4.00.

From International colloquium on measurement of irradiation enhanced creep in nuclear materials; Petten, Netherlands (5 May 1976).

Over the past six years at EBR-II, a great deal of information has been obtained on the in-reactor behavior of solution annealed-Type 304L stainless steel. This information consists of the following: (1) Irradiation induced swelling results in the form of immersion density and transmission electron microscopy (TEM) measurements on unstressed material that extend over a temperature range of 395 to 530°C and a neutron fluence range of 1.8 x 10^{22} to 9.3 x 10^{22} n/cm² (E greater than 0.1 MeV). (2) Irradiation induced creep results from helium pressurized capsules irradiated at a temperature of 415°C. The hoop stress range covered in the experiment was 0 to 27.3 ksi, and the peak neutron fluence obtained to date is 7.6 x 10^{22} n/cm² (E greater than 0.1 MeV). (3) Residual stress measurements (slit tube technique) with complementary TEM gradient studies on stressed and unstressed capsules. (4) Comparative swelling studies of stressed cladding material and unstressed capsule material from encapsulated EBR-II driver fuel experiments over wide ranges of temperature and neutron fluences.

26124 (HEDL-SA—1011) **Microstructure of neutron irradiated stainless steels.** Brager, H.R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract E(45-1)-2170. 34p. (CONF-750952—5). Dep. NTIS $4.00.

From Seminar on radiation-produced defects and defect clusters and their effects in metals; Ames, Iowa, USA (28 Sep 1975).

A review is given of some aspects of microstructure in neutron-irradiated austenitic stainless steel, with emphasis on several variables which influence void formation. It is shown that (1) swelling does not saturate with increasing neutron fluence, (2) cold work has major influence on temperature dependence of void formation (swelling), (3) peak swelling in cold work steel is associated with enhanced growth of voids on precipitates, (4) variation of minor alloy constituents significantly influences swelling, and (5) duration of pre-irradiation heat treatment affects swelling. 28 fig.

26125 (HEDL-SA—1039) **Irradiation effects evaluation of reference 20% CW type 316.** Holmes, J.J.; Bennett, J.W. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. Contract E(45-1)-2170. 26p. (CONF-7510107—3). Dep. NTIS 4.00.

From US-German cladding information exchange; Germantown, Maryland, United States of America (USA) (14 Oct 1975).

Radiation effects of fast neutrons at less than or equal to 760°C on 316 stainless steel specimens are reported. Data and information are included on mechanical properties of engineering materials, in-reactor deformation behavior of materials, and radioinduced swelling. (JRD)

26126 (HEDL-TME—76-13) **Cladding and structural materials. Semi-annual progress report, July 1975—January 1976.** Claudson, T.T. (comp.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1976. Contract E(45-1)-2170. 241p. Dep. NTIS $8.00.

Progress on experimental programs and evaluation of results is given for radiation damage studies to LMFBR cladding and structural materials. The primary material being studied is 316 SS in various conditions of cold work and in the welded condition. Tensile, creep, and swelling property data on unirradiated and irradiated 316 SS cladding and duct specimens at various test conditions are provided. The importance of stress on the properties of 316 SS is highlighted. Results on core dosimetry and damage analysis indicate the increasing value of detailed core characterization. 105 figures, 21 tables.

26127 (JAERI-M—5829, pp 145-153) **Study of radiation damage by X-ray diffraction.** Maeta, H. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

X-ray diffraction method is useful for the study on the state of defects produced by the irradiation of neutrons or particles. It is necessary to measure the physical properties, such as electrical resistance and linear expansion, for the study of irradiation defects. Volume change is due to the change of lattice constants. Measurements of lattice constants and length were made for Cu irradiated by deuterons, and Al and Cu irradiated by neutrons. The defects produced by irradiation recover with temperature rise. Therefore, it is necessary to keep samples at low temperature during irradiation and measurement. An X-ray diffraction system for extremely low temperature was designed and constructed. The most important part is a glass cryostat, with which irradiated samples can be set in a measuring apparatus without temperature rise after irradiation. Measurement of the lattice constant of Mo irradiated by neutrons at 5°K was carried out. The single crystal of Mo was annealed in ultra high vaccum at 1600°C in advance. A recovering stage was observed, and Frenkel pair disappeared. The ratio between the recovery of electrical resistance and that of lattice constant $(\Delta a/a)/\Delta rho$ of Mo is different from that of Nb which is BCC metal same as Mo. Concentration of the defects produced by irradiation can be observed by neutron scattering experiment. Nikulaus et al. performed the measurement of the contribution to electrical resistance and volume expansion for Al. The scattering cross-section due to Frenkel pair was 0.05 - 0.1 m barn per unit solid angle. Study of radiation damage by using Haung scattering was carried out by Erhart.

26128 (JAERI-M—5829, pp 87-91) **Problems of reactor materials.** Nagasaki, R. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Existence of the high temperature neutron damages of reactor materials has been confirmed by the operation of fast reactors. The characteristics are phenomenally reviewed about technological irradiation behavior so far. The volume increase of Ni-alloys and stainless steels for fuel sheaths of fast breeder reactors is an important problem of commercial reactors. The irradiation behavior of the materials can be classified by temperature into about four cases 1) knockout damage at lower than 0.3Tsub(m), 2) void formation in the range of 0.3 -- 0.5Tsub(m), 3) bubble formation at not lower than 0.5Tsub(m), and 4) different atom formation by nuclear conversion in whole temperature range, in which Tsub(m) is melting point of materials. Fast neutron irradiation causes not only the volume increase but also the change of mechanical properties. For example, maximum tensile strength has no relation with irradiation dose, but total elongation reduces from 20% to 2 -- 3% on high temperature side. The helium bubbles in metals are

not only preferentially generated on grain boundaries or dislocation lines, but also move with the movement of grain boundaries to coalesce and grow. According to the recent precise experimental study of heavy ion irradiation with accelerators, voids form the same crystal lattice as their material.

26129 (JAERI-M—5829, pp 155-166) **Neutron damage of superconductors.** Okada, T. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Irradiation effects on Nb-Ti wire as a practical material and vanadium single crystal for basic research were experimentally studied. Point defects and their assembly introduced by irradiation may have influence on the superconductivity of the second kind of superconductive material in cases that the superconductive property depending on the mean free path of conductive electrons is changed, and that the mechanism of pinning of flux lines is influenced and consequently the critical current density (Jsub(c)) is changed. Four examples of experiments performed on the latter case are shown. (1) Change in Jsub(c) of Nb-Ti and Nb-Zr when they were irradiated with 3.5 x 10^{18}n/cm^2 of fast neutrons was examined. (2) A V-single crystal plate of 25 x 2 x 0.074mm was used to examine the irradiation effect on Jsub(c). (3) Comparison between low temperature irradiation and normal temperature irradiation was made on V single crystal. (4) The relationship between the pre-irradiation treatment and composition of superconductive wire material was examined. Fundamental problems in future are the study of phonon structure for elucidating the neutron irradiation effect on critical temperature Tsub(c), dynamical understanding of flux pinning, and the best dislocation cell structure as flux pinner. Problems of application are the analysis of the irradiation effect on Jsub(c) of practical material as the composite effect of stabilizer damage and superconductor damage, the difference of effects in low temperature irradiation from high temperature irradiation, and the dynamical side of neutron irradiation effects. On the basis of these studies, the influence on large magnets is evaluated.

26130 (JAERI-M—5829, pp 135-143) **Radiation damage of metals.** Okuda, S. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Properties and formation problems of interstitial atoms are reviewed as it is important for the irradiation experiment at ultralow temperature. The interstitial atoms of face centered cubic metals, those of body centered cubic metals, and the distribution of irradiation defects are described. Experiments were performed under the irradiation of neutron flux of 1 x 10^{12} n/cm^2 sec (>0.1 MeV) with JRR 3 reactor at temperature not lower than 5K. In the face centered cubic crystals, elasticity in whole crystal is influenced by the interstitial atoms formed in the crystal. The influence arises in three kinds. The first is increase in elasticity by the fixation of dislocations. The second is decrease in elasticity by the alignment due to the rotation of anisotropic interstitial atoms to the direction of external force. The third is decrease in elasticity by softening of lattice due to the lattice strain around the interstitial atoms. In the body centered cubic crystals, it is conceivable that the interstitial atoms on low temperature side are free, but the interstitial atoms on high temperature side are trapped by impurities. The restoration of electric resistance of Mo after irradiation, and the change in elasticity of single crystal of Mo by neutron irradiation at about 5K were experimentally examined. In irradiation defects, the distance between interstitial atoms and voids can be measured indirectly by the following methods. One is a method of measuring the recovery of deformation in liquid helium after ultralow temperature irradiation. The other is a method using the alloy of super-lattice. The experiments revealed that the distance can be expected to be -- 10 times as long as the distance between atoms.

26131 (JAERI-M—6094) **Calculations on displacement damage and its related parameters for heavy ion bombardment in reactor materials.** Sone, K.; Shiraishi, K. (Japan Atomic Energy Research Inst., Tokyo). Apr 1975. 39p. (In Japanese). INIS.

The depth distribution of displacement damage expressed in displacements per atom (DPA) in reactor materials such as Mo, Nb, V, Fe and Ni bombarded by energetic nitrogen, argon and self ions with incident energy below 2 MeV was calculated following the theory developed by Lindhard and co-workers for the partition of energy as an energetic ion slowing down. In this calculation, energy loss due to electron excitation was taken into account for the atomic collision cascade after the primary knock-on process. Some parameters indispensable for the calculation such as energy loss rate, damage efficiency, projected range and its straggling were tabulated as a function of incident ion energy of 20 keV to 2 MeV. The damage and parameters were also calculated for 2 MeV nickel ions bombarding Fe targets. In this case, the DPA value is of 40--75% overestimated in a calculation disregarding electronic energy loss for primary knock-on atoms. The formula proposed in this report is significant for calculations on displacement damage produced by heavy ion bombardment as a simulation of high fluence fast neutron damage.

26132 **Implantation of atoms into materials during reactor operation.** Andresen, H.; Lutze, W.; Migge, H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany)). pp 49-55 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

Nuclear reactions which lead to the formation of hydrogen and helium in nuclear reactor materials are discussed in detail. The extent of materials damage resulting from these, as well as other atoms implanted in reactor materials as a result of hot atom reactions, is discussed. The relevance of neutron-induced hot atom reactions in fusion technology is also discussed.

26133 **Chemical studies of ion implantation.** Maddock, A.G. (Cambridge Univ. (UK). Chemical Lab.). pp 33-43 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

Various methods used for studying the environment and the chemical and electronic states of ion-implanted atoms are presented and their strengths and limitations discussed. An account is given of the correlation between the behaviour of ion-implanted and nuclear recoil generated atoms in complex solids, and details of experiments to determine differences in behaviour are presented.

26134 **Effects of ion implantation on amorphous Gd—Co.** Venturini, E.L.; Richards, P.M.; Borders, J.A.; EerNisse, E.P. (Sandia Labs., Albuquerque, NM). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 119-120(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Studies of stress, composition, and magnetic resonance have been made on amorphous Gd—Co thin films implanted with nitrogen ions at fluences between 10^{16} and 10^{16} ions/cm^2. A new mode of magnetic resonance is produced in a small portion of the implanted region. In this portion H/sub A/ - 4πM decreases with fluence and ultimately achieves a negative value considerably larger in magnitude than 4πM in the film prior to the implantation. This behavior is interpreted as arising from a decrease in the Gd—Co exchange interaction which reduces the alignment of the Gd spin system.

26135 **Austenitic stainless steels with improved resistance to radiation-induced swelling.** Bloom, E.E.; Steigler, J.O.; Rowcliffe, A.F.; Leitnaker, J.M. (Oak Ridge National Lab., TN). *Scr. Metall.*; **10**: No. 4, 303-308(Apr 1976).

Stainless steel specimens were bombarded with Ni ions at elevated temperatures to simulate fast neutron damage. Results show that type 316 stainless steel with additions of silicon and titanium exhibits low swelling over the entire swelling temperature range under high-dose nickel-ion bombardment. Neutron irradiation data on commercial alloys and ion data on high-purity alloys also indicate that the most effective suppression of swelling is achieved with combinations of silicon and titanium. It is suggested that suppression of swelling by alloying with silicon and titanium may be effective over a range of nickel and chromium base composition levels and will provide the basis for the development of low-swelling alloys that are technologically similar to type 316 stainless steel. It should be noted that the influence of silicon and titanium on swelling is likely to depend strongly on the concentrations of other elements such as carbon, oxygen, and nitrogen and on the extent to which silicon and titanium partition to various phases.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 26919

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 25452, 25453, 25455, 25999, 26255

26136 (CONF-760831—1) **Reduction of impurity ions in MgO by current flow at high temperature.** Weeks, R.A.; Sonder, E.; Pigg, J.C.; Kelton, K.F. (Oak Ridge National Lab., Tenn. (USA)). Jul 1976. Contract W-7405-eng-26. 18p. Dep. NTIS $3.50.

From 2. Europhysics topical conference; Berlin, German, Federal Republic of (F.R. Germany) (30 Aug 1976).

Results of a study of the reduction of transition metal impurity ions in MgO due to passage of electric current are reported. Fields of the order of 10^3 V/cm and temperatures between 950 and 1150°C were used. Trivalent impurities, Fe^{3+} and Cr^{3+} could be almost completely reduced, whereas divalent Mn^{2+} was not greatly changed. V^{2+} appeared after treatment; presumably vanadium had been in the 3+ state in the original MgO. The results further indicate that the reduction process is not uniform throughout the samples, that it can be reversed by heating in the absence of an electric field, and that it is accompanied by the creation of defects that act as shallow electron trapping sites at room temperature.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 25450

26137 (JAERI-M—5829, pp 1-11) **Neutron diffraction and lattice defects.** Hamaguchi, Y. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Study on lattice defects by neutron diffraction technique is described. Wave length of neutron wave is longer than that of X-ray, and absorption cross-section is small. Number of defects observed by ESR is up to several defects, and the number studied with electron microscopes is more than 100. Information obtained by neutron diffraction concerns the number of defects between these two ranges. For practical analysis, several probable models are selected from the data of ESR or electron microscopes, and most probable one is determined by calculation. Then, defect concentration is obtained from scattering cross section. It is possible to measure elastic scattering exclusively by neutron diffraction. Minimum detectable concentration estimated is about 0.5% and 10^{20} - 10^{21} defects per unit volume. A chopper and a time of flight system are used as a measuring system. Cold neutrons are obtained from the neutron sources inserted into reactors. Examples of measurements by using similar equipments to PTNS-I system of Japan Atomic Energy Research Institute are presented. Interstitial concentration in the graphite irradiated by fast neutrons is shown. Defects in irradiated MgO were also investigated by measuring scattering cross section. Study of defects in Ge was made by measuring total cross section, and model analysis was performed in comparison with various models.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 26113, 26150, 26160

26138 (LA-UR—76-1535) **Pressure dependence of T/sub c/ for carbides of thorium, yttrium, and scandium.** Giorgi, A.L.; Hill, H.H.; Szklarz, E.G.; White, R.W. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 9p. (CONF-760464—7). Dep. NTIS $3.50.

From 2. Conference on superconductivity in d- and f-bands; Rochester, New York, United States of America (USA) (30 Apr 1976).

The effect of pressure on the T/sub c/ of Y_2C_3, Th_2C_3, and two ternary (Th/sub x/Y/sub 1-x/)$_2C_3$ alloys (all b.c.c. Pu_2C_3-type structure) was determined. Measurements were also made on the new superconducting germanium stabilized scandium carbide and on a germanium stabilized thorium-yttrium-carbide. The pure binary compounds exhibited negative values for the dT/sub c//dP. Relatively strong positive pressure dependence was observed for the ternary compositions.

26139 **Magnetic interactions in europium hexaboride.** Glaunsinger, W.S. (Arizona State Univ., Tempe). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 412-414(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

EuB_6 samples of widely separated electron density were studied by EPR. In bulk samples, narrow signals have been observed and attributed to conduction electrons coupled to the europium moments. The exchange field increases linearly with temperature above the temperature range where critical spin fluctuations occur. The europium resonance splits into 2 lines below 21 K, and the splitting increases with decreasing temperature, with the low-field line being considerably more intense than the high-field line, which is unobservable near 10 K. Several models for the exchange interaction between the europium moments have been examined, and it is found that the RKKY interaction can account for the magnitude of the high-temperature exchange field in bulk EuB_6, but that another interaction, quite possible the BR interaction, makes the dominant contribution to its temperature dependence. The splitting of the europium resonance, which cannot be attributed to crystalline-electric-field effects, may result from a magnetic transition, possibly involving magnetic-polaron formation.

26140 **Magnetooptical studies on spin-reorientation in rare earth orthoferrites.** Koshizuka, N.; Hayashi, K.; Suzuki, M.; Tsushima, T. (Electrotechnical Lab., Tokyo). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 647-648(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Several types of spin-reorientation (SR) in some of the $RFeO_3$ are studied by Faraday rotation measurements; rotational SR of $GAMMA_4$ yields $GAMMA_2$ type in (ErSm)FeO_3, (Co^{2+}, Ti^{4+}) doped $YFeO_3$, and abrupt SR of $GAMMA_4$ yields $GAMMA_1$ type in $DyFeO_3$. Observations of SR by Faraday rotation were made in these crystals with incident light parallel to the optical axis. In relation with the decrease of Fe^{3+} ion's anisotropy at T/sub SR/, an abrupt decrease of the coercive force are found in these systems. In general, Faraday rotation in $RFeO_3$ originates from Fe^{3+} ions in the visible and near IR regions, while R^{3+} ion's contribution to the Faraday rotation was observed for the wavelengths corresponding to the electronic transitions of R^{3+} ions in $ErFeO_3$ and $DyFeO_3$ at low temperatures. In $DyFeO_3$, a large contribution of Dy^{3+} ions was observed at approximately 1.2 μm in the Faraday spectrum, and it is confirmed that the Dy^{3+} moments are polarized along the c-axis in zero applied field above T/sub SR/. Magnetic field induced SR was also observed in $DyFeO_3$, and the temperature dependence of the critical field was obtained as H/sub SR/ varies as absolute value T - T/sub SR/3/4.

26141 **X-ray spectroscopic investigation of carbides and nitrides of group IV and V transition metals.** Shulakov, A.S.; Zimkina, T.M.; Fomichev, V.A.; Neshpor, V.S. (A. A. Zhdanov Leningrad State University). *Sov. Phys. - Solid State (Engl. Transl.)*; **18**: No. 3, 455-457(Mar 1976).

X-ray emission bands of group IV and V transition metals, representing the distribution of the d valence states, were determined at very long wavelengths. The structure of the d-like bands of metals belonging to one group was very similar for monotypic compounds, and it was a function of the electron concentration. The electron structures of niobium carbide and nitride were investigated in detail. The groups of electron states participating in various spatial bonds were identified. Measurements of the relative integrated intensities of the N/sub 2,3/ and M/sub 4,5/ bands of zirconium and niobium in compounds indicated the transfer of some of the d electrons of these metals to the spheres of the lighter component. (AIP)

26142 **Measurement of the absorption of wide-band semiconductor materials in the 10-μm region from their thermal emission.** Krutyakova, V.P.; Oksman, Y.A. *Sov. J. Opt. Technol. (Engl. Transl.)*; **43**: No. 4, 256-258(Apr 1976).

The absorption coefficients of GaAs and ZnSe crystals and the KO-6 optical ceramic have been measured in the interval from 100 to 300°C from the thermal emission in the 10-μm region. The lack of a temperature dependence of the absorption of the ZnSe crystals and the KO-6 ceramic is considered an indication of the existence of strongly absorbing inclusions in these materials. (AIP)

CORROSION AND EROSION

26143 (ANL—75-74) **Interactions of certain refractory materials with sodium.** Fink, J.K.; Heiberger, J.J.; Kumar, R.; Blomquist, R.A.; Leibowitz, L.; Sowa, E.S.; Pavlik, J.R.; Baker, L. Jr. (Argonne National Lab., Ill. (USA)). May 1976. Contract W-31-109-Eng-38. 43p. AT.

Commercial refractories of alumina, magnesia, zirconia, and silica, as well as samples of graphite, thoria, beryllia, boron carbide, and quartz, were tested for compatibility with high-tempera-

ture and boiling sodium. Samples were exposed either to static sodium at 850°C for five hours or to boiling sodium for about an hour. Graphite, thoria, beryllia, boron carbide, and refractories with high alumina or magnesia contents, but with low silica and chromic oxide contents, were found to be compatible with high-temperature and boiling sodium. Sample compatibility with sodium decreased with an increase in the silica content of the sample. Samples with large silica content failed completely. Bricks with high zirconia content did not withstand exposure to boiling sodium, but high-fired zirconia crucibles appeared to be in good condition after sodium exposure. Except for the results with the high-zirconia bricks, the results of the ANL experiments with refractory bricks are in good agreement with those obtained in sodium compatibility experiments done at Westinghouse Advanced Reactors Division. 36 Figs.

26144 (LA-UR—76-1134) **Chemical interactions of insulator materials in CTR environments.** Hoffman, J.G. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 12p. (CONF-760558—2). Dep. NTIS $3.50.

From CTR insulator meeting; Los Alamos, New Mexico, United States of America (USA) (17 May 1976).

The stringent demands for materials performance in an operational CTR power system require careful consideration and planning to avoid unacceptable deletorious interactions between components. Efforts have begun to identify potential problem areas and experiments are in progress to understand the fundamental aspects of these new materials problems. Two long-term experiments are in progress to study these interactions, specifically reactor irradiations of refractory metal/ceramic interfaces and the atomic hydrogen erosion problem. A high-purity polycrystalline alumina probe directly exposed to a deuterium plasma was examined to determine the effects of the plasma bombardment. Though the surface was altered through erosion or flash melting, the probe surface was intact and exhibited no signs of mechanical or electrical failure.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 25451, 26132, 26133

26145 (LA-UR—76-1131) **Structural effect in neutron irradiation of insulating ceramics.** Hurley, G.F. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 10p. (CONF-760558—1). Dep. NTIS $3.50.

From CTR insulator meeting; Los Alamos, New Mexico, United States of America (USA) (17 May 1976).

A vacuum gap irradiation capsule was designed and built to maintain a temperature of 740°C during 6 weeks irradiation at EBR-II. Sixty-eight samples of 15 ceramic or metal-ceramic combinations were irradiated to a fluence of approximately 3 x 10^{21} neutrons/cm², E greater than 0.1 MeV. Measurements of sample dimensions before and after irradiation were used to determine volume swelling. This parameter and the physical appearance of the samples are discussed. A primary application of insulating ceramics in proposed fusion powder devices is the first wall insulating lining in the RTPR reactor. A satisfactory material for this application must bear substantial thermal stresses in cyclical fashion. Calculated values of pertinent parameters are presented and compared for several of the irradiated materials in non-irradiated form. Work to prepare apparatus for the measurement of thermal and mechanical properties of these materials following neutron irradiation is described. Silicon nitride is representative of a class of refractory ceramics distinguished by its high thermal conductivity, resistance to thermal shock, and elevated temperature strength retention. Recent work has suggested that Si_3N_4 hot pressed with additions of Y_2O_3, rather than the usual MgO, may offer improved high temperature strength. A project to prepare samples of this material with optimized Y_2O_3 concentration and pressing conditions is described. Samples of Si_3N_4 hot pressed with 0, 5, 10, 15, and 20 wt percent Y_2O_3 additions have been prepared for an irradiation experiment being carried out by ORNL at EBR-II.

26146 (LA-UR—76-1298) **Nature of radiation damage in ceramics.** Bunch, J.M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 17p. (CONF-760558—4). Dep. NTIS $3.50.

From CTR insulator meeting; Los Alamos, New Mexico, United States of America (USA) (17 May 1976).

Efforts to determine the equivalence between different sources of radiation damage in ceramics are reviewed. The ways in which ceramics differ from metals are examined and proposed mechanisms for creation and stabilization of defects in insulators are outlined. Work on radiation damage in crystalline oxides is summarized and suggestions for further research are offered. (JRD)

COMPOSITE MATERIALS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 26149

26147 **Fabrication and superconducting properties of Nb_3Al multifilamentary composites.** Hafstrom, J.W.; Thresh, H.R. (Argonne National Lab., IL). *Appl. Polym. Symp.*; No. 29, 37-46(1976).

From Conference on new and specialty fibers; Chicago, IL, USA (26 Aug 1975).

The metallurgy, fabrication techniques, and superconducting properties of mono- and multifilamentary aluminum-stabilized Nb_3Al wire fabricated by bulk diffusion processes are presented. Emphasis is placed on the relationship of the superconducting properties to the process parameters. High superconducting critical-current densities are possible in Nb_3Al, fabricated by diffusion, only by increasing flux pinning through the reduction of the grain size to below 1 μm. Results of experiments on the control of grain size through the use of nonoxide dispersions and short diffusion times are reported. It was found that the Nb_3Al layer thickness is the most significant factor influencing J/sub c/(H). Zirconium additions were found to accelerate layer growth, thus enabling quite short reaction times.

26148 **Fabrication of multifilament NbTi composite wire for accelerator applications.** Strauss, B.P.; Remsbottom, R.H.; Reardon, P.J. (Fermi National Accelerator Lab., Batavia, IL). *Appl. Polym. Symp.*; No. 29, 53-59(1976).

From Conference on new and specialty fibers; Chicago, IL, USA (26 Aug 1975).

Magnets for the Fermilab Energy Doubler Accelerator will cycle from 1.0 to 4.5 T and back every 30 s. In order to minimize thermal losses in these magnets, filament size must be minimized, the matrix of the composite separated by high resistivity material, and the filaments twisted to prevent coupling. Cost considerations also dictate that the critical current be maximized in order to cut costs. This work reviews the methods used to manufacture superconducting cables that meet these criteria. The metallurgical processing parameters that affect the kinetics of optimizing the performance of these conductors are discussed. 8 figs.

26149 **Stability of A-15 compounds in multifilamentary superconducting wires.** Luhman, T.; Horigami, O.; Dew-Hughes, D. (Brookhaven National Lab., Upton, NY). *Appl. Polym. Symp.*; No. 29, 61-70(1976).

From Conference on new and specialty fibers; Chicago, IL, USA (26 Aug 1975).

With the preeminence of A-15 superconducting multifilamentary wires in magnet technology, it has become important to understand the thermodynamic factors influencing the formation of these compounds under solid-state reaction conditions. The six systems Nb - Sn, Nb - Ga, Nb - Ge, Nb - Al, V - Si, and V - Ga were prepared as single filament bronze wires and heat treated in an attempt to precipitate the appropriate A-15 compound. The compounds observed to form were categorized using a formation temperature ratio (stability index) based on the melting temperatures of the constituents which make up the single filament composites. This study has led to several predictions regarding the formation of A-15 compounds using a solid-state bronze diffusion technique. Results of experimentation based on these predictions are presented.

26150 **Superconducting thin film niobium carbonitrides on carbon fibers.** Pike, G.E.; Pierson, H.O.; Mullendore, A.W.; Schirber, J.E. (Sandia Labs., Albuquerque, NM). *Appl. Polym. Symp.*; No. 29, 71-81(1976).

From Conference on new and specialty fibers; Chicago, IL, USA (26 Aug 1975).

The preparation and characteristics of a new superconducting wire material, consisting of a 7 μm carbon filament substrate thinly coated with niobium carbonitride, are reported. These filaments are coated (approximately 1000 at a time as a yarn) by a chemical vapor deposition (CVD) process in which the carbonitride is deposited as a compound. $NbCl_5$ is the source gas for Nb, either N_2, $(CH_3)_3N$, $(CH_3)_2NH$, or NH_3 is the source gas for N, and either CH_4 or the amines is the source gas for C. Equilibrium thermochemical calculations for the most important reactions were conducted for a range of temperatures. A review is also made of that part of the Nb—N—C phase diagram which pertains to superconducting compositions and the effect of composition on the superconducting transition temperature T/sub c/ is examined. Reaction temperatures between 600 and 1200°C were used to produce carbonitrides with transition temperatures up to 16.9°K. The effect of CVD parameters on T/sub c/, the width of the transi-

tion, and the coating grain size are discussed. It is found that increasing the CVD time or temperature tends to broaden the superconducting transition. Some evidence for slight reaction with the carbon substrate is found.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 26116

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

26151 (UCRL—13500) **Union Carbide cellular silicones. Final report.** Smith, F.A. (Union Carbide Corp., Tarrytown, N.Y. (USA). Research and Development Dept.). Aug 1972. Contract 9860207. 46p. Dep. NTIS $4.00.

For Univ. of California, Livermore.

An improved base for cellular silicone materials was developed utilizing end-blocked polysiloxane gum, resulting better reproducibility of properties from lot to lot, better processing properties, and lower compression set values. Y-3260 and Y-3333 were manufactured on a production scale and found to be superior to standard cellular silicone materials with respect to reproducibility of the gum, base compound, and final cellular cushions. The new materials also possess good processibility, easily meeting dimensional tolerances over a long period of compound storage. The lower Williams Plasticity Test values show improved plastic flow and a reduction in the molding pressures required to make complicated shapes. These new cellular silicone compounds permit the manufacture of silicone rubber cushions which have the lowest compression set test values ever obtained. The new materials recovered all but 6 to 10 percent of the standard test deformation of 50 percent for 22 hours at 300°F; compared to the 15 percent or more lost by the present product; this is a significant improvement and represents a loss of about 0.002 inches in thickness for a 0.060 inch thick cushion. The products gave better thickness uniformity in typical shaped parts at molding pressures of only one-third that used for standard material. Initial efforts in the area of easy processing and extended shelf life of cellular silicones indicate this goal could be achieved with a minimum of compromises utilizing the newly developed base. Recommendations for future investigation are included. (DLC)

OTHER MATERIALS

PREPARATION AND MANUFACTURE

26152 (JAERI-M—5829, pp 129-133) **Recent topics on lattice defects.** Suzuki, H. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Recent topics on lattice defects are reviewed. Positron annihilation has been used for the determination of the Fermi surface of alloys. Study of lattice defects is also possible with the phenomena of positron annihilation, since the probability of pair annihilation of electron and positron trapped at vacancy is small. Study of radiation damage can be made with super high voltage electron microscopes. Precise discussion on the kinematics of recovery of the point defects due to radiation has become to be made. The anisotropy of ejection energy will be determinable. Dynamic theory of dislocations has been developed. A theory for phonon scattering by vibrating dislocations was compared with experiment. The uniform motion of dislocations in crystal, and the interaction of dislocations and conductive electrons have been studied. Behavior of the lattice defects in quantum solid was investigated. The vacancy in it is named as defection, and the state is designated by quasimomentum K. Dislocations in solid helium was studied. The theory of dislocations of liquid and noncrystalline substances in also introduced.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 26137

26153 (JAERI-M—5829, pp 33-39) **How to 'visualize' lattice defects.** Doi, K. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Methods to recognize objects are discussed. In case of optics, lenses are used, and light from objects passing through the lenses focuses on focal planes. The amplitude of light on the focal planes in given as a function of the structure factor of scattering light from objects, images of objects are made on image planes. In case of X-ray or neutron diffraction, lenses which make images by X-ray or neutrons can not be made, accordingly images cannot be obtained. Images can be seen with electron microscopes. By X-ray or thermal neutron diffraction, intensity on focal planes in observed, and the defects to be studied are recognized as diffuse scattering. Since it is necessary to minimize aberration in case of image observation with electron microscopes, slits are used to utilize electron beam near optical axis exclusively. Therefore large resolving power cannot be expected. The information concerning structure obtained from focal planes is of statistical nature, and that from image planes is local information. The principle of neutron topography, by which the informations concerning local points are obtained, is explained. A photograph of LiF irradiated by 0.5 MeV proton beam was taken by the topographic method, and shown in this paper.

26154 (JAERI-M—5829, pp 13-22) **Structure and phase transition of interstitial compounds.** Hirabayashi, M. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Study on the crystalline structure and phase transition of interstitial compounds by using neutron scattering is described. Experiments on the hydride of heavy metals are explained. Diffusion constant of hydrogen atoms in Nb was obtained by neutron quasi-elastic scattering. Local phonon energy of H in Nb was measured by inelastic scattering. Spinodal lines were shown in a phase diagram. Study of V-D, V-H, Ta-D, and Ta-H systems was made by neutron scattering. Remarkable difference is seen between the phase diagrams of V-d and V-H systems. Difference of phase transition temperature was several tens degrees. Occupation probability of lattice points by D atoms is determined as a function of concentration and temperature. Remarkable isotope effect as seen in the V-H and V-D systems was not observed between Ta-D and Ta-H systems. Difference of transition temperature was several degrees. Inelastic scattering spectra of TaHsub(0.5) and VHsub(0.5) were measured by TOF method. Remarkable change is seen in αyieldsβ, transition in VHsub(0.5), while it is not seen in TaHsub(0.5). This is consistent with the measured results of the local mode of H in V, Nb and Ta.

26155 (JAERI-M—5829, pp 23-32) **Problems on one-dimensionally disordered lattices, and reliability of structural analysis of liquids and amorphous solids.** Kakinoki, J. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Methods for obtaining the intensity of X-ray diffraction by one-dimensional by disordered lattices have been studied, and matrix method was developed. The method has been applied for structural analysis. Several problems concerning neutron diffraction were shown in the course of analysis. Large single crystals should be used for measurement. It is hard to grasp the local variation of structure. The technique of topography is still in development. Measurement of weak intensity diffraction is not sufficient. Technique of photography to observe overall feature is not good. General remarks concerning the one-dimensionally disordered lattices are as follows. A large number of parameters for analysis are not practical, and the disorder parameters are preferably two. In case of the disorder between two kinds of layers having same frequency and different structure, peak shift is not caused, and Laue term remains at the position. Reliability of the structural analysis of liquid and amorphous solid is discussed. Basically the analysis is that of a diatomic molecule of same kind of atoms. The intensity of diffraction can be obtained from radial distribution function (RDF). Since practical observation is limited to a finite region, termination effect should be taken into consideration. Accuracy of analysis is not good in case of X-ray diffraction. The analysis by neutron diffraction is preferable.

26156 (MLM—2334(OP)) **NMR studies of FeTiH/sub x/.** Bowman, R.C.; Attalla, A.; Tadlock, W.E. (Mound Lab., Miamisburg, Ohio (USA)). 1976. Contract E-33-1-GEN-53. 12p. (CONF-760348—1). Dep. NTIS $3.50.

From Meeting of the American Physical Society; Atlanta, Georgia, United States of America (USA) (29 Mar 1976).

Various pulse NMR techniques have been used to determine the proton lineshapes and relaxation times for β-phase

$FeTiH_{1.1}$ and γ-phase $FeTiH_{1.7}$. The resonance signals for both phases have very short free induction decay (FIDs) (i.e., T_2^* approximately 2 to 5 μs) which are inhomogeneously broadened. Spin echo measurements of T_2 indicate that proton diffusion in FeTiH/sub x/ is insufficient to significantly reduce the dipolar interactions. The spin-lattice relaxation times for both phases are primarily due to conduction electrons. The temperature and frequency dependences of the relaxation times have been measured and are discussed in terms of probable FeTiH/sub x/ structure.

26157 Neutron scattering investigation of the central mode and acoustic phonon anomaly arising from the Jahn—Teller phase transition in $TbVO_4$. Hutchings, M.T. (Institute Laue-Langevin, Grenoble, France); Scherm, R.; Smith, S.R.P. *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 372-378(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Neutron scattering techniques have been used to study the low-lying excitations in terbium vanadate at and above the structural phase transition, a cooperative Jahn-Teller phase transition caused by the electron-phonon coupling between the Tb^{3+} ions and the lattice. Above the transition temperature at 33°K, T/sub D/, the lowest Tb^{3+} ion levels are two singlets separated by approximately 0.49 THz, and a doublet midway between them. The principal interaction is with the (100) transverse acoustic phonon mode and its effect increases as T yields T/sub D/. The phonon couples almost equally with the electronic transitions between the degenerate levels of the doublet and between the singlet levels. The neutron scattering cross section from the system is dominated by the nuclear scattering, and the phase transition is characterized by a sharp anisotropic central (zero frequency) mode due to the coupling of the phonon to the electronic doublet, whose intensity diverges as T yields T/sub D/, q yields 0. The coupling with the singlet-singlet transition gives rise to an anticrossing with the (100) phonon which increases as T yields T/sub D/. Using linear response theory techniques an expression for the complete scattering function S(vector Q, ω) has been derived, and in a simplified form this has been used to interpret the data on the central mode, confirming its origin.

26158 Spin-Peierls transitions in Heisenberg antiferromagnetic linear chain systems. Bray, J.W. (General Electric Co., Schenectady, NY); Hart, H.R. Jr.; Interrante, L.V.; Jacobs, I.S.; Kasper, J.S.; Watkins, G.D.; Wee, S.H.; Bonner, J.C. *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 504-505(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Magnetic susceptibility and EPR measurements at 1.5 to 300°K were made on the compounds $TTF.MS_4C_4(CF_3)_4$, where TTF = tetrathiafulvalene and M = M = Cu or Au. Results are in good agreement with a mean-field theory of the spin-Peierls transition embracing the 1-D uniform Heisenberg AF chain, 3-D lattice dynamics and spin-phonon coupling. Solution of the Frohlich-type Hamiltonian leads to a BCS-like temperature-dependent magnetic gap and a progressive dimerization of the lattice below T/sub c/. (DLC)

PROPERTIES

REFER ALSO TO CITATION(S) 26066, 26073, 26077, 26667

26159 (IS-T—721) **Electromodulation spectroscopy of sc and fcc phase TlCl and TlBr.** McClelland, J.F. (Ames Lab., Iowa (USA)). Jun 1976. Contract W-7405-eng-82. 125p. Dep. NTIS $5.50.

Thesis. Submitted to Iowa State Univ. of Science and Technology, Ames.

Electromodulation measurements were made on these compounds and the spectra were reduced to the electric field induced changes in the dielectric function. The results indicate the importance of photocarrier effects in both theory and experiment in the electromodulation of exciton states. In the future, calculations should include the effect of photocarriers on the field seen by the exciton and experimentally samples should be developed with known and reproducible photocarrier properties with temperature control between liquid helium and nitrogen temperatures and bipolar modulation fields. The abnormal (fcc) phase electroabsorption (EA) measurements have demonstrated the usefulness of the modulation method in resolving exciton states by determining the n = 2 energy in TlBr. This has enabled a number of quantities to be calculated from the Wannier exciton model. The resolution of the n = 2 energy in TlCl is probably also possible with an EA measurement and patience with the signal to noise problem. The α and β features are still unassigned but the unusual EA lineshape and sample preparation sensitivity found in this investigation may prove useful in making definitive assignments in conjunction with future work.

26160 (LA-UR—76-1567) **EPR studies of excited state exchange and crystal-field effects in rare earth compounds.** Huang, C.Y.; Sugawara, K.; Cooper, B.R. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 11p. (CONF-760920—1). Dep. NTIS $3.50.

From 2. international conference on the crystal field effects in metals and alloys; Zurich, Switzerland (1 Sep 1976).

EPR in excited crystal-field states of Tm^{3+}, Pr^{3+}, and Tb^{3+} in singlet-ground-state systems and in the excited state of Ce^{3+} in CeP are reviewed. Because one is looking at a crystal-field excited state resonance, the exchange, even if isotropic, does not act as a secular perturbation. This means that one obtains different effects and has access to more information about the dynamic effects of exchange than in conventional paramagnetic resonance experiments. The Tm and Pr monopnictides studied are paramagnetic at all temperatures. The most striking feature of the behavior of the $GAMMA_8$/sup (2)/ EPR in the Tm compounds is the presence of an anomalous maximum in the temperature dependence of the g-factor. The relationship of this effect to anisotropic exchange is discussed. The results of the EPR of the excited $GAMMA_8$/sup (2)/ level of Tb_3^+ (g-factor becomes very large at T/sub N/ in antiferromagnetic TbX (X = P, As, Sb) and that of the excited $GAMMA_8$ level of Ce^{3+} in antiferromagnetic CeP will also be reported. For sufficient dilution of the Tb^{3+} in the terbium monopnictides, the systems become paramagnetic (Van Vleck paramagnets) down to 0°K. The Tb^{3+} excited state resonance EPR in Tb/sub 0.1/ La/sub 0.9/P was studied as an example of behavior in such systems. 10 fig.

26161 (ORNL-tr—4183) **Dielectric strength of SF_6 in ac and dc inhomogeneous fields.** Sangkasaad, S. Translated by E.G. Silver from *Elektrotech. Z., A*; **96**: No. 11, 515-519(1975). 18p. Dep. NTIS $3.50.

The corona threshold behavior and breakdown behavior of SF_6 in the inhomogeneous field of a rod-plate geometry was investigated in the pressure range from 0.2 to 6 bar. The measurements were made with dc and 50-Hz ac voltages up to 250 kV peak value. Results showed that corona inception and breakdown voltage not only depend on the gas pressure, but are also strong functions of the inhomogeneity of the field. With a constant electrode separation distance an approximately constant minimum value of the breakdown voltage was observed, which however appeared at different gas pressures, depending on the degree of field inhomogeneity. A relationship for predicting the minimum breakdown voltage is given as function of the electrode separation distance. The spark channels were photographed at different gas pressures and results discussed. Measured and calculated values of the initiation voltages are compared. 10 figures.

26162 Reduction of the apparent anisotropy of bubble garnet films under aluminum metallization. Wolfe, R.; Johnson, W.A. (Bell Labs., Murray Hill, NJ). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 117-118(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The magnetic field parallel to the surface of a garnet film which results in nucleation of a sea of bubbles, is lower for regions covered by an evaporated Al film than for the bare garnet. This field, which is related to the anisotropy field, H/sub k/, decreases further under the Al when the specimen is annealed at temperatures up to 450°C (as much as 40 percent below the bare garnet value). The value of the in-plane bubble nucleation field returns to normal when the Al is removed. The effect is still present, but reduced in magnitude, when a spacer layer of SiO_2 up to 1.2 μm thick is deposited on the garnet beneath the Al film. The effect is therefore not related to a chemical interaction between the Al and the garnet. H/sub k/ as determined from demagnetized domain stripe width and bubble collapse measurements is essentially unchanged under the Al film. This effect is interpreted in terms of stress gradients associated with granularity of the Al metallization.

26163 Magnetic anisotropy of Ho^{3+} in holmium—aluminum—garnet. Egami, T. (Univ. of Pennsylvania, Philadelphia); Flanders, P.J.; Gyorgy, E.M.; Van Uitert, L.G. *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 121-122(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The field induced magnetocrystalline anisotropy of Ho^{3+} in Aluminium garnet was measured by the torque method at 4.2°K in magnetic fields up to 70 kOe and compared to the magnetization.

The exponent of the power law, kappa$_4$ varies as m/sup n/, was found to be 4 when m is small and to approach gradually to 10 as m was increased, as has been predicted by Callen and Callen; this measurement is the first confirmation of the power law of the field induced anisotropy.

26164 Localized moments and magnetic interactions in Fe-doped layer compounds $NbSe_2$ and $TaSe_2$. Coleman, R.V. (Univ. of Virginia, Charlottesville); Fleming, R.M.; Whitney, D.A.; Domb, E.R.; Sellmyer, D.J. *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 400-401(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Localized moments and magnetic interactions were studied in the Fe-doped layer compounds Fe/sub x/$TaSe_2$ and Fe/sub x/$NbSe_2$ for .01 less than x less than .10. For small x the Fe impurities carry a localized magnetic moment as indicated by magnetic susceptibility measurements and, in a number of cases, Kondo-like behavior is observed in the transport properties. At larger values of x there is evidence for an ordered magnetic state at low temperatures.

26165 Magneto-caloric effect studies on single crystal $MnCl_2.4H_2O$ with magnetic fields applied along the c crystallographic axis. Butera, R.A.; Reichert, T.A.; Schiller, E.J. (Univ. of Pittsburgh). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 447-449(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

The magneto-caloric effect was determined over the temperature range from 0.4 to 1.7°K with applied magnetic field up to 20 kG. Correlation of the variation of (delta T/delta H)/sub S/ with the transition boundaries were determined and evidence that the adiabats do not cross the spin flopped to paramagnetic boundary tangentially is discussed. Results suggesting that an additional transition is occuring in the heretofore considered paramagnetic region at fields greater than 9 kG are presented.

26166 Studies of magnetooptical effects in garnets thin film waveguides. Hepner, G.; Castera, J.P.; Desormiere, B. (Laboratoire Central de Recherches, Orsay, France). *AIP (Am. Inst. Phys.) Conf. Proc.*; No. 29, 658-659(1976).

From 21. annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

See CONF-751209—.

Mode conversion in Gd-Ga substituted YIG films grown on GGG are studied for guided light at 1.15 μm. The films are magnetized either parallel or perpendicular to propagation, so that conversion is obtained through the Faraday or the Cotton-Mouton effect. Depending on the substitution ratio in YIG, easy in-plane or bubble films are obtained. For easy in-plane films, the birefringence induced by epitaxy is found to favor the mode conversion. In this case, conversion ratios of 75 and 50 percent were obtained for the Faraday and Cotton-Mouton configuration, respectively. These two kinds of mode converters could be used to build a non-reciprocal integrated optical device.

26167 Phonon spectra of Chevrel-phase lead and tin molybdenum sulfides: A molecular-crystal model and its implications for superconductivity. Bader, S.D.; Knapp, G.S.; Sinha, S.K.; Schweiss, P.; Renker, B. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.*; 37: No. 6, 344-348(9 Aug 1976).

Heat-capacity (2—400 K) and inelastic-neutron-scattering studies of the phonon spectra are reported for superconducting, high-critical-field, Chevrel-phase, lead and tin molybdenum sulfides (T/sub c/~11—15 K). Nine phonon modes per unit cell are identified whose frequencies are in the immediate region Bergmann and Rainer indicate is necessary to optimize T/sub c/. Acoustic-phonon softening on cooling is observed. A molecular-crystal model is proposed for the lattice dynamics of these materials. (AIP)

26168 Direct correlation of phonon anomalies in NbC with Fermi-surface: induced maxima in generalized susceptibilities. Gupta, M.; Freeman, A.J. (Magnetic Theory Group, Department of Physics, Northwestern University, Evanston, Illinois 60201). *Phys. Rev. Lett.*; 37: No. 6, 364-367(9 Aug 1976).

The generalized susceptibility of NbC, determined from its augmented plane wave energy band structure (with constant matrix elements), shows large maxima, arising in large part from Fermi surface "nesting," to occur at precisely those q values at which soft modes have been found in the phonon acoustic branches by Smith. These maxima can be represented by a warped cube of dimension ~1.2(2π/a) in momentum space, in striking agreement with the soft mode surface proposed by Weber. (AIP)

26169 Ultrasonic measurements at elevated pressures (9 GPa) to determine Poisson's ratio and other elastic moduli of NaCl and NaF. Morris, C.E.; Jamieson, J.C.; Yarger, F.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Appl. Phys.*; 47: No. 9, 3979-3986(Sep 1976).

Transit times of longitudinal and transverse ultrasonic waves were measured simultaneously in NaCl and NaF as a function of "quasihydrostaticκ pressure to 9 GPa. The dimensionless ratio of these transit times yields directly the ratio of the longitudinal to shear velocity. This velocity ratio is independent of sample length. Using third-order elasticity theory a correction for a probable superimposed uniaxial stress component may be made. When done, this allows the direct determination of Poisson's ratio for each pressure. Shock-wave data are used to obtain other elastic moduli and velocities of shear and longitudinal waves. Apparatus for making these measurements is described and data for NaCl and NaF are presented. (AIP)

26170 Magnetic susceptibility of /sup 249/Cf in an octahedral environment. Karraker, D.G.; Dunlap, B.D. (Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, South Carolina 29801). *J. Chem. Phys.*; 65: No. 5, 2032-2033(1 Sep 1976).

The magnetic susceptibility of Cf/sup 3+/ doped into Cs_2NaYCl_6 is reported over the temperature range 2.2 to 100°K. (AIP)

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 25885

RADIATION EFFECTS

26171 (AD-A—010782) **Hardened hybrid semiconductor packages. Task II. Final report, 1 Jan—31 Jan 1975.** Lindberg, F.A. (Westinghouse Defense and Electronic Systems Center, Baltimore, Md. (USA). Systems Development Div.). May 1975. Contract DAAG39-73-C-0216. 27p. NTIS $3.75.

The work was performed to develop a radiation hardened packaging technique for packaging a whole round semiconductor wafer. The metal which connected the wafer bonding pads to the package output pins was aluminum which was vapor deposited through a mask on the inside surface of the package. One end of each conductor line was lifted off the package surface to form a beam lead. These beam leads were then ultrasonically bonded to the wafer bonding pads.

CHEMISTRY

REFER ALSO TO CITATION(S) 26034

ANALYTICAL AND SEPARATIONS CHEMISTRY

26172 (PNCT—831-74-01, pp 74-76) **Zircaloy-2 standards for instrumental analysis (ZR1-4).** Tsutsumi, K.; Motoyama, S.; Ouchi, Y.; Terunuma, T.; Okamoto, M. May 1974.

In Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. Jul.-Dec., 1973.

Four series of Zircaloy-2 standards were prepared for the use in instrumental analysis. After the confirmation of homogeneity, the contents of 10 elements were determined by the co-analysis of related 3 laboratories. The standards were manufactured by arc melting, pressing, heat treatment, and so on, using reactor-grade spongy zirconium and the mother alloys prepared from mixed particles of spongy zirconium, tin, iron, chromium, nickel, silicon, aluminum, cobalt, copper, manganese, and titanium. The standard rods thus prepared were 40 mm in diameter and 150 mm in length. Homogeneity of the standard samples, by the expression with the coefficient of variation, was 1.0 to 5.0% for tin, iron, chromium, copper, and nickel, and 5.0 to 14.3% for aluminum, silicon, cobalt, manganese, and titanium. The values adopted for the certificate of analysis are as follows: Sn (1.89, 1.67, 1.31, 1.09%), Fe (0.075, 0.119, 0.171, 0.214%), Cr (0.044, 0.074, 0.104, 0.134%), Ni (0.023, 0.050, 0.073, 0.095%), Al (54, 68, 81, 104 ppm), Cu (16, 28, 44, 52 ppm), Mn (10, 13, 16, 22 ppm), Si (15, 51, 85, 119 ppm), Ti (5, 22, 41, 56 ppm), Co (2, 5, 10, 15 ppm).

26173 Annual review of biophysics and bioengineering. Volume 4. Mullins, L.J.; Hagins, W.A.; Stryer, L.; Newton, C. (eds.). Palo Alto, CA; Annual Reviews, Inc. (1975). 610p. $12.00.

Topics covered include: EEG analysis; computer methods in electrocardiography; thermal properties of biomaterials, the physiological model, computer-aided instruction in medicine, chemotaxis in bacteria, muscle structure and contraction, electron microspectroscopy, spatial organization in animal development, determination of structure by neutron scattering application of intensity fluctuation spectroscopy to molecular biology, physical state of diffusible ions in cells, fluorescent probes in nerve membranes, concentration correlation spectroscopy, antibiotics and membrane biology, biomedical materials, calcium transport, artificial kidneys, survival distribution, computer monitoring in patient care, structure of tRNA, and computers in the clinical pathologic laboratory. Separate abstracts were prepared for two papers. (MCG)

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 25269

26174 (BNL—21513) **Interpretation of neutron activation analysis data of ancient silver.** Meyers, P.; van Zelst, L.; Sayre, E.V. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. Contract E(30-1)-16. 20p. (CONF-760350—1). Dep. NTIS $3.50.

From Archaeometry and archaeological prospecting; Edinburg, United Kingdom of Great Britain and Northern Ireland (UK) (24 Mar 1976).

Results from work on Sasanian silver and objects from related periods and geographic provenances are used to demonstrate that analytical data in combination with other properties can be used with reasonable success in establishing groups of objects of common geographic provenances, in providing information on the production, use, and distribution of silver metal, and on ancient metal working techniques. (LK)

26175 (TRITA-KKE—7503, pp 18-20) **Multi-element analysis.** Jan 1975. (In Swedish).

In Development and application of methods for analysis of mercury, cadmium etc. SNV report for 73-74.

Multi-element analysis has been performed on slurries with neutron activation analysis. The samples were dried and sealed into quartz glass before neutron irradiation. The concentrations of 19 elements has been calculated from gamma spectra.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 25449, 26186

26176 (ORNL/MIT—230) **Elution electrophoresis as a clinical tool.** Wilkes, G.R.; Bertolami, R.J.; Choi, W.M.; Terpandjian, P.D. (Massachusetts Inst. of Tech., Oak Ridge, Tenn. (USA). School of Chemical Engineering Practice). 24 Mar 1976. 47p. Dep. NTIS $4.00.

An experimental investigation of an elution electrophoresis system with a particulate gel packed column was performed. The operating parameters of the apparatus were determined with elution flow studies and electrophoresis migration studies. Flow study results indicated that sample dispersion is dependent on packing type, packing size, elution flow rate, and outlet geometry. Migration studies revealed that sample migration is dependent upon the packing type, packing size, buffer solution, and applied voltage. The best available operating system was selected from a composite of the results. Minimum criteria for feasibility were an established difference in migration rates for different pure samples and maintenance of the separation during elution. Electrophoresis at 1000 v in a 40-cm column packed with Bio-Gel P2, 200-400-mesh packing was performed on a sample for 30 min. The sample was eluted from the column at an eluent flow rate of 8 ml/hr. Measurable migration rates were obtained for an albumin sample. Migration for pure samples of A, AC, and F hemoglobins was not apparent. Also, electrophoresis of a mixture of these hemoglobins at the operating conditions optimum for albumin migration produced no separation of the hemoglobin mixture. Lack of migration and lack of separation with the hemoglobin samples led to the conclusion that the present operating conditions and apparatus are unsuitable for analysis of hemoglobins. A new column design for future experimentation is suggested.

26177 **Enthalpies of solution of potassium chloride and 2-amino-2-(hydroxymethyl)-1,3-propanediol (Tris).** Gayer, K.H.; Kothari, P.S. (Wayne State Univ., Detroit). *Thermochim. Acta;* **15**: No. 3, 301-305(Jun 1976).

The performance of 2-amino-2-(hydroxymethyl)-1,3-propanediol (Tris) and potassium chloride as solution calorimetry comparison standards has been evaluated. It has been established that both of these have some drawbacks, but of the two Tris is the preferable calorimeter comparison standard.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 25733

26178 (AD-A—011311) **Gamma-ray spectrometer study. Final contract report, Jun 1972—1 Apr 1975.** Haralick, R.M.; Adams, J. (Kansas Univ. Center for Research, Inc., Lawrence (USA). Remote Sensing Lab.). Feb 1975. Contract DAAK02-72-C-0550. 57p. (CRES-TR—227-2). NTIS $4.25.

Gamma-ray spectrometer measurements have been applied to a large variety of problems in rock and soil mapping, terrain analysis, trafficability, snow water equivalent estimation, detection of environmental contamination by nuclear fission products, and direct and indirect mineral exploration. Fuller utilization of gamma spectrometric outputs is currently limited by the inadequacy of data reduction and presentation techniques. This report describes a data reduction technique designed to detect spatially contiguous ground regions which are homogeneous in thorium, uranium, and potassium content. The data reduction technique was applied to gamma-ray spectrometric data obtained at an altitude of 50 feet in the Garden City, Kansas area. Results indicate that 83% of the homogeneous areas detected by the technique can be directly interpreted on the basis of information contained in simultaneously obtained imagery. (GRA)

26179 (BNWL—2000(Pt.4), pp 14-17) **In situ monitoring.** Feb 1976.

In Pacific Northwest Laboratory annual report for 1975 to the ERDA Division of Biomedical and Environmental Research.

Systems for in situ analysis of radionuclides around storage areas and nuclear sites are being developed. The development and initial use of an intrinsic Ge system for the determination of Pu and Am in soils were completed. A method based on gamma-ray analysis of grazing animal thyroids was developed as a possible method for U and Th exploration using their ^{228}Ra and ^{226}Ra daughters.

26180 (HASL—307) **Determination of environmental levels of ^{239,240}Pu, ^{241}Am, ^{137}Cs, and ^{90}Sr in large volume sea water samples.** Sutton, D.C.; Calderon, G.; Rosa, W. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). Jun 1976. 47p. Dep. NTIS $4.00.

A method is reported for the determination of environmental levels of ^{239,240}Pu and ^{241}Am in approximately 60-liter size samples of seawater. ^{137}Cs and ^{90}Sr were also separated and determined from the same samples. The samples were collected at the sea surface and at various depths in the oceans through the facilities of the Woods Hole Oceanographic Institution. Plutonium and americium were separated from the seawater by iron hydroxide scavenging then treated with a mixture of nitric, hydrochloric, and perchloric acids. A series of anion exchange separations were used to remove interferences and purify plutonium and americium; then each was electroplated on platinum disks and measured by solid state alpha particle spectrometry. The overall chemical yields averaged 62 +- 9 and 69 +- 14 percent for ^{238}Pu, and ^{243}Am tracers, respectively. Following the iron hydroxide scavenge of the transuranics, cesium was removed from the acidified seawater matrix by adsorption onto ammonium phosphomolybdate. Cesium carrier and ^{137}Cs isolation was effected by ion exchange and precipitations were made using chloroplatinic acid. The samples were weighed to determine overall chemical yield then beta counted. Cesium recoveries averaged 75 +- 5 percent. After cesium was removed from the seawater matrix, the samples were neutralized with sodium hydroxide and ammonium carbonate was added to precipitate ^{85}Sr tracer and the mixed alkaline earth carbonates. Strontium was separated as the nitrate and scavenged by chromate and hydroxide precipitations. Yttrium-90 was allowed to build up for two weeks, then milked and precipitated as the oxalate, weighed, and beta counted. The overall chemical yields of ^{85}Sr tracer averaged 84 +- 16 percent. The recovery of the yttrium oxalate precipitates averaged 96 +- 3 percent.

26181 (TRITA-KKE—7503, pp 13-18) **Method for analysis of inorganic mercury in presence of methyl mercury.** Jan 1975. (In Swedish).

In Development and application of methods for analysis of mercury, cadmium etc. SNV report for 73-74.

An isotope exchange method for quantitative analysis of inorganic mercury in presence of methyl mercury has been developed and tested. The analysis is performed in three phases: 1. Nitrogen is passed through a generator for Hg^0-steam, Hg^0 is activated through isotope exchange with $^{203}Hg^{2+}$ in two gas wash bottles, $^{203}Hg^0$ in the gas activates in the same way the Hg^{2+} in the sample, the gas is dried, the $^{203}Hg^0$ is absorbed on active carbon and is then measured. 2. Soluted $^{202}Hg^0$ is taken away with nitrogen gas. 3. Hg^0-steam is changed against $^{202}Hg^{2+}$ in the sample vessel and the $^{203}Hg^0$-steam is absorbed on active carbon for analysis. The method of analysis has shown excellent.

26182 (TRITA-KKE—7503, pp 21-23) **Measuring instrument for detection of cadmium.** Jan 1975. (In Swedish).

In Development and application of methods for analysis of mercury, cadmium etc. SNV report for 73-74.

A prototype of a portable measuring instrument for detection of cadmium in different products is described. When the instrument is heldc against an object concentrations of cadmium of 0.1 % can be measured. The principle for the measurement is x-ray fluorescence with iodine-125 as excitating radiation source. To measure concentrations of 0.1 %, 1 min measuring time is neaded.

26183 Engelman, D.M.; Moore, P.B. (Yale Univ., New Haven). pp 219-241 of In Determination of quaternary structure by small angle neutron scattering. Mullins, L.J. (ed.). Palo Alto, CA; Annual Reviews, Inc. (1975).

A survey is presented of small angle neutron scattering with an emphasis on its application to the study of the spatial organization of subunits of macromolecular structures. Included is a discussion of: background, theory, instrumentation, the contrast matching technique, and the current status of the use of small angle neutron scattering in biological studies. (DDA)

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 25227, 26234

26184 (BNWL—2000(Pt.4)) **Pacific Northwest Laboratory annual report for 1975 to the ERDA Division of Biomedical and Environmental Research. Part 4. Physical and analytical sciences and analysis and assessment.** Nielsen, J.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1976. Contract E(45-1)-1830. 132p. Dep. NTIS $7.00.

Separate abstracts were prepared for 16 sections of this report. A list is included of 21 publications during the time period covered. (CH)

26185 (BNWL—2000(Pt.4), pp 2-13) **Low-level radiological chemistry laboratory techniques.** Feb 1976.

In Pacific Northwest Laboratory annual report for 1975 to the ERDA Division of Biomedical and Environmental Research.

Newly developed electronic and computer technology together with improved low-background construction materials and techniques have aided in developing more sensitive radiation instrumentation. Backgrounds have been reduced by 10-fold at the Th and U photopeak areas, as well as 20- to 100-fold in the ^{40}K photopeak region for NaI (Tl) spectrometers and from 5-fold for Th and U to 30-fold for ^{40}K for Ge(Li) spectrometers. High sensitivity x-ray analysis with intrinsic Ge, coupled with computer techniques, allowed measurements of specific tracers for resuspension studies and the determination of ^{241}Am and ^{244}Cm. Techniques were also developed to measure the neutron erosion of CTR construction materials.

26186 (BNWL—2000(Pt.4), pp 18-23) **Environmental pollution analysis.** Feb 1976.

In Pacific Northwest Laboratory annual report for 1975 to the ERDA Division of Biomedical and Environmental Research.

To understand the physical and chemical behavior of inorganic pollutants in the environment, it is essential that techniques be developed to sample and measure pollutants at their source, during their transport and throughout the environment. To meet some of these needs: 1) a method developed in 1974 was further refined for the in situ analysis of trace element pollutants in sediments by x-ray fluorescence for measurement of up to 30 elements at the 2-50 ppM levels; 2) plasma excitation techniques were advanced for chemical species determination of As and Sb; and 3) sampling methods and gas chromatograph techniques for inorganic and organic gases have undergone further development.

26187 (IS-T—708) **Analytical lines for long-path infrared absorption spectrometry of air pollutants using diode lasers.** Golden, B.M. (Ames Lab., Iowa (USA)). Jun 1976. Contract W-7405-eng-82. 85p. Dep. NTIS $5.00.

Thesis.

A scheme for selecting resonant frequencies for the analysis of gaseous air pollutants using long-path absorption of narrow-band infrared sources is presented. A computer search is conducted using existing spectrometric data to determine lines with minimum interference and maximum sensitivity. Results are given for the pollutants O_3, N_2O, CO, CH_4, and the non-polluting species, H_2O and CO_2. In addition, accurate absorption line half-widths of NO were determined using a conventional high resolution infrared spectrometer and modern data-taking procedures.

26188 (IS-T—719) **Determination of ultratrace quantities of the toxic metals in biomedical and environmental samples.** Nixon, D.E. (Ames Lab., Iowa (USA)). Jun 1976. Contract W-7405-eng-82. 136p. Dep. NTIS $6.00.

Thesis.

The pneumatic nebulization system cannot introduce a sufficient quantity of the analyte into the plasma to determine As, Se, Te, Sb, Sn, and Ge at ultratrace concentrations. Stray light from the emission of concomitants present in real samples also seriously detracts from the usefulness of the inductively coupled plasma (ICP) simultaneous multielement analysis system. This flaw is due to defects in the optical components. Adaptation of the much publicized thermal vaporization and atomization technique to the ICP was successful only for the analysis of essentially pure water solutions containing analytes at trace concentrations. The constraints and limitations discovered for the analysis of real samples nullify any advantages thought to be derived from the coupling of an electrothermal vaporization device to the ICP. Of the physicochemical separation and preconcentration methods investigated, only the distillation method was completely compatible with the present plasma facilities. This separation scheme provided a simple and specific method for the quantitative isolation of As, Se, Sn, and Ge from concomitants in biomedical and environmental samples. The determination of very low analyte concentrations in biofluids was implemented by preconcentration using the digestion-distillation approach. 20 figures, 11 tables, 145 references.

26189 (ORNL/TM—5422) **Interlaboratory comparison of trace metal analyses by graphite furnace (flameless) atomic absorption spectroscopy.** Turner, R.R.; Lindberg, S.E. (Oak Ridge National Lab., Tenn. (USA)). Jul 1976. Contract W-7405-eng-26. 28p. Dep. NTIS $4.00.

The analytical sensitivity, precision, and accuracy of trace metal (Pb, Cd, Cr, Cu, Fe, and Mn) analyses on aqueous samples performed at ORNL using a flameless graphite furnace atomic absorption system were evaluated in comparison to analyses performed by three independent laboratories using similar systems. All laboratories analyzed replicates of the same five samples which included twice distilled water, two U.S. EPA reference trace metal standards and two natural water samples. Analyses performed at ORNL were generally superior with respect to sensitivity and precision to those performed elsewhere. Approximate limits of detection, as indicated by analyses of the distilled water performed at ORNL, were close to those claimed by the instrument manufacturer. No one laboratory reported values which were consistently more accurate than those reported by the others and from some laboratories replicate values for the reference standards varied considerably. The best overall combination of precision and accuracy on the reference sample with the lowest concentrations (0.2 to 2.8 $\mu g/l$) was exhibited by ORNL. In contrast, ORNL exhibited the poorest combination of precision and accuracy on the reference sample with the highest concentration (2 to 28 $\mu g/l$). Subsequent analyses of new reference standards by ORNL indicated accurate values for lead. Results reported for the natural water samples suggested that the flameless atomic absorption method is sufficiently sensitive to quantitatively detect concentrations of selected trace metals in natural water without preconcentration procedures.

26190 (ORNL/TM—5505) **Practical aspects of the resin bead technique for mass spectrometric sample loading.** Walker, R.L.; Pritchard, C.A.; Carter, J.A.; Smith, D.H. (Oak Ridge National Lab., Tenn. (USA)). Jul 1976. Contract W-7405-eng-26. 19p. Dep. NTIS $3.50.

Using an anion resin bead as a loading vehicle for uranium and plutonium samples which are to be analyzed isotopically in a mass spectrometer has many advantages over conventional techniques. It is applicable to any laboratory routinely performing such analyses, but should be particularly relevant for Safeguards' purposes. Because the techniques required differ markedly from those of conventional methods, this report has been written to describe them in detail to enable those unfamiliar with the technique to master it with a minimum of trouble.

26191 (PNCT—831-74-01, pp 59-61) **Determination of small-amounts of silicon in Zr-Nb alloys by anion exchange separation-molybdenum blue photometry.** Suzuki, T.; Tsutsumi, K.; Tsuji, N. May 1974.

In Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. Jul.-Dec., 1973.

In a polyethylene beaker, 0.5 g of a Zr-Nb alloy sample was dissolved with 10 ml distilled water, 5 ml of HF (1+4) solution, and 5-10 drops of HNO_3 (1+1). This solution was passed through an anion exchange column with 7 mm inner diameter and 100 mm high. The column was then washed twice with 10 ml of HNO_3 (1+25) solution. Then silicon was washed out, and niobium remained by being adsorbed on resin bed. To whole of the passing and washing solution, 30 ml of 4% H_3BO_3, 10 ml of HNO_3 (1+25), and a few drops of 0.1% $KMnO_4$ were added, until the solution

was colored. Then 1 ml of 5% NaCl and 5 ml of 10% ammonium molybdate solution were added. After mixing, the solution was left as it was for 15 minutes. Then 5 ml of 20% tartaric acid and 5 ml of reduction reagent solution were added. The solution was diluted to 100 ml with distilled water. Silicon was determined by measuring the absorption intensity at 820 nm after being left for 30 minutes. The addition of hydrofluoric acid is essential in the separation of niobium by the anion exchange resin. This effect was proved by tracer experiment with the use of Nb-95. The proposed procedure was satisfactory for the analysis of 0.5 g of 2.5% Nb-Zr alloy containing 40 μg of silicon.

26192 (PNCT—831-74-01, pp 62-67) **Determination of traces of calcium sodium and magnesium in zirconium alloy by atomic absorption spectrometry.** Suzuki, T.; Kondo, I.; Tsutsumi, K.; Tsugi, N. May 1974.

In Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. Jul.-Dec., 1973.

In a polyethylene beaker, 2 g of a sample was dissolved with 30 ml of water and 5 ml of HF. Some residue remained was dissolved with the addition of a few drops of HNO_3. The solution was then passed through a cation exchange resin column. Zirconium and niobium were eluted with 70 ml of HF (1 : 99), while calcium remained in the column. Calcium was eluted from the column with 100 ml of HCl (1+1). The solution was heated until the volume was reduced to about 5-10 ml. Potassium chloride solution, equivalent to 60 mg of potassium, was added to the solution. The solution was then diluted to 50 ml. Calcium in the diluted solution was measured by a Perkin Elmer Model 403 atomic absorption spectrophotometer. For the determination of sodium and magnesium, 2 g of a sample was dissolved with 40 ml of water and 20 ml of HF (1+4). If necessary, a few drops of HNO_3 was added to completely dissolve the residue. The solution was diluted to 100 ml. Both sodium and magnesium were determined by atomic absorption method. The use of acetylene-nitrous oxide flame restrained the interference by chromium and iron, which were eluted with calcium. The determination was made with wave lengths of 422.7, 589.0, and 285.2 nm for calcium, sodium, and magnesium, respectively.

26193 (UCRL—76163) **Quantum Raman spectroscopy. II. Isotope ratio measurements in oxygen and nitrogen.** Bloom, S.D.; Harney, R.C.; Milanovich, F.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1975. Contract W-7405-eng-48. 11p. (CONF-750103—3). Dep. NTIS $3.50.

From Meeting of the American Physical Society; Anaheim, California, USA (29 Jan 1975).

Measurements of the $^{14}N^{15}N/^{14}N^{14}N$ and $^{16}O^{18}O/^{16}O^{16}O$ Raman intensity ratios have been made in air samples and pure gas samples. A high-resolution double monochromator was used with a C31034A-02 PM tube to count the photons scattered from a low-powered laser beam (1—2 watts). Standard high-speed modular electronics (approximately 10 ns resolution) were used to process the output pulses. The $\Delta J = 0$ vibrational bands of $^{14}N^{15}N$ and $^{16}O^{18}O$ were observed to be essentially free of all interference except dark noise of approximately 3 counts/sec. The adjacent rotational structure of $^{14}N^{14}N$ and $^{16}O^{16}O$ showed no appreciable overlap with the $\Delta J = 0$ bands of interest. Detailed spectra, comparison of the Raman intensity ratios with mass spectrometer isotope ratios, and Raman cross section data for $^{14}N^{15}N$ and $^{16}O^{18}O$ are presented. The applicability of Raman scattering as a technique for precision measurement of isotope ratios is discussed.

26194 (UCRL—76164) **Quantum Raman spectroscopy. I. High resolution spectra of air.** Harney, R.C.; Bloom, S.D.; Milanovich, F.P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract W-7405-eng-48. 13p. (CONF-750103—2). Dep. NTIS $3.50.

From Meeting of the American Physical Society; Anaheim, California, USA (29 Jan 1975).

High resolution (0.1—1.0 cm^{-1}) Raman spectra of air samples have been obtained using an automated photon-counting Raman spectrometer. Light scattered from a 1 to 2 watt Ar^+ laser beam (lambda = 4880 Å) was analyzed with a SPEX 1401 double monochromator containing 2400 g/mm holographic gratings. The Raman signal was detected by a C31034A-02 PM tube coupled to either a ratemeter and chart recorder or high speed (approximately 10 MHz) electronics. The laser power was monitored by an 8575 PM tube. The automated system controlled the scaler units, a line printer, and the wavelength drive. Details of the spectrometer and data acquisition system are presented as well as spectra of ambient air using quantum counting with data relating to band shapes, line widths, and other molecular parameters. Some of these new results differ substantially from those obtained by less direct methods.

26195 (UCRL—78347) **Computerized mass spectrometer data system at LLL.** Friesen, R.D.; Dupzyk, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jun 1976. Contract W-7405-eng-48. 7p. (CONF-760524—3). Dep. NTIS $3.50.

From Conference on mass spectrometry and allied topics; San Diego, California, United States of America (USA) (9 May 1976).

The data systems on the three mass spectrometers at LLL are computer-controlled, pulse-counting systems synchronized to a repeatedly swept magnetic field. The data are accumulated in the memory of the computer or in a Nuclear Data ND 180 in a multiscaler mode of operation. This mode of data acquisition allows a continuous check of the background stability and makes tune-up easier. But the main benefit is a reduction in the required ion emission rate stability. By the use of standards to set the system dead time, we have been able to utilize the sensitivity of a pulse counting system without the expense of exotic equipment.

26196 **Electron microspectroscopy.** Isaacson, M.S.; Crewe, A.V. (Univ. of Chicago). pp 165-184 of In Annual review of biophysics and bioengineering. Mullins, L.J. (ed.). Palo Alto, CA; Annual Reviews, Inc. (1975).

When a beam of monoenergetic electrons crosses a thin specimen many of the electrons lose energy by exciting or ionizing atoms within the specimen. A combination of electron microscope and electron spectrograph is used to analyze the energy of the transmitted electrons to determine the distribution of energy losses within the specimen. This energy loss spectrum is characteristic of the material being analyzed and can be used to identify the specimen. This method of microanalysis is capable of better spatial resolution than previous methods using focused beams of charged particles. (DDA)

26197 **Photoelectron spectroscopy of carbonyls. Ureas, uracils, and thymine.** Dougherty, D.; Wittel, K.; Meeks, J.; McGlynn, S.P. (Louisiana State Univ., Baton Rouge). *J. Am. Chem. Soc.*; **98**: No. 13, 3815-3820(23 Jun 1976).

The photoelectron spectra of the six possible methyl ureas, two acyl ureas, and four uracils have been obtained. Many of the low-energy set of ionization events in these molecules have been assigned empirically on the basis of methylation and other substitution effects. The data are then correlated with CNDO/s MO energies and are compared with other semiempirical and ab initio computational results which are available in the literature.

26198 **Electron spin resonance spectrum of the perfluorocyclobutane radical anion.** Shiotani, M.; Williams, F. (Univ. of Tennessee, Knoxville). *J. Am. Chem. Soc.*; **98**: No. 13, 4006-4008(23 Jun 1976).

The ESR spectrum was presented for the perfluorocyclobutane radical anion prepared by γ radiation at 77°K of a solid solution of 5 mole percent of perfluorocyclobutane in neopentane. Studies were performed using photobleaching experiments by exposing the sample to unfiltered light from a tungsten lamp. (DDA)

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 26222, 26531

26199 (MHSMP—76-17W) **High speed gel permeation chromatography calibration procedures. Period covered: January—March 1976.** Kohn, E.; Ashcraft, R. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. Contract DA-11-173-AMC-487(A). 16p. Dep. NTIS $3.50.

A High Speed Gel Permeation Chromatograph (HSGPC) calibration curve was generated by use of approximately 160 calibration runs employing polystyrene and hydrocarbon standards which were fitted by a fifth degree polynomial. Three substances, the peroxide of tetrahydrofuran, o-dichlorobenzene, and HMX were evaluated as internal standards to correct for small fluctuations in flow rate from run-to-run, and were found to be satisfactory. The utility of a composite calibration mixture was also established.

26200 (ORNL-tr—4172) **Program for design of static plate absorbers with consideration of all usual feed paths of material and heat.** Nagel, S. Translated by R.G. Mansfield from *Chem.-Ing.-Tech.*; **44**: No. 6, 416-420(1972). 9p. (CONF-710998—1). Dep. NTIS $3.50.

From Annual meeting of process engineers; Nuremberg, German, Federal Republic of (F.R. Germany) (21 Sep 1971).

For calculating the static behavior of absorber columns, the familiar mathematical model using enthalpy balance, mass balance, and phase equilibrium is used. The real behavior of the liquid phase is described by the Wilson formula. For the exchange of material a plate efficiency is considered. Different variants of adiabatic and nonadiabatic ways of conducting the process can be

treated. Side inlets and outlets (with and without recycle into the column) and heat exchangers in the streams of material are taken into account. Possible applications of the model are illustrated by examples. The comparison between calculated and measured values from the literature was satisfactory. (auth)

26201 Adsorption of inorganic materials on activated carbon. Nelson, F.; Phillips, H.O.; Kraus, K.A. (Oak Ridge National Lab., TN). pp 1076-1090 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Application of activated carbon to adsorption and separations reactions can be greatly extended by filling the carbon with various additives. The effects on selectivities and capacities of a few strongly adsorbed, low molecular weight, organic acids (including substituted phenols) and the alteration of properties by incorporating inorganic additives (particularly iron oxides) into the carbon are reviewed. Most of the work was carried out with commercial, powdered activated carbon Aqua Nuchar A or a granular coconut charcoal but comparative analyses were also performed for seven other carbons. Most analyses were carried out radiometrically with appropriate gamma emitting isotopes or by standard atomic absorption methods. (PCS)

26202 (ORNL-tr—4170) **Interfacial areas and mass transfer coefficients in various types of gas-liquid absorbers and reactors: review paper.** Laurent, A.; Charpentier, J.C. Translated by M. Gerrard from *Chem. Eng. J. (Lausanne)*; **8**: 85-101(1974). 22p. Dep. NTIS $3.50.

Results are presented of determinations of interfacial areas and mass transfer coefficients for use in designing or scaling up of all types of gas-liquid absorbers and reactors in industry. 74 references, 18 figures. (auth)

26203 Scale-up of a mixer-settler extractor using a unit operations approach. Lindholm, D.C.; Bautista, R.G. (Ames Lab., IA). *Trans. Soc. Min. Eng. AIME;* **260**: No. 1, 1-5(Mar 1976).

The results of scale-up studies on a continuous, multistage horizontal mixer-settler extractor are presented. The chemical and mechanical system involves the separation of lanthanum from a mixture of rare earth chlorides using di(2-ethylhexyl) phosphoric acid as the solvent and dilute HCl as a scrub solution in a bench scale extractor. Each stage has a hold-up of 2.6 l. A single stage unit is utilized for scale-up studies. Results are obtained on four sizes of geometrically similar units, the largest being six times the volume of the original bench size. A unit operations technique is chosen so that mixing and settling can be examined independently. Variables examined include type of continuous phase, flow rate of inlet streams, and power input to the mixer. Inlet flow-rate ratios are kept constant for all tests. Two potential methods of unbaffled pump-mixer scale-up are explored; the maintenance of constant impeller tip speed and constant power input. For the settler, the previously successful method of basing design on constant flow-rate per unit cross-sectional area is used.

26204 Design criteria for uranium ion exchange in a fluidized system. Traut, D.E.; Nichols, I.L.; Seidel, D.C. (Bureau of Mines, Salt Lake City). *Trans. Soc. Min. Eng. AIME;* **260**: No. 1, 24-28(Mar 1976).

From AIME annual meeting; New York, NY (Feb 1975).

A fluidized countercurrent ion-exchange system was developed, operated, and evaluated by the Bureau of Mines. The system consisted of integrated multiple- compartment absorption and elution columns in which the solution flows are continuous except for short periods when resin increments are withdrawn. The exchange of uranyl sulfate between a simulated acid leach uranium solution and a strong-base, ion-exchange resin together with the subsequent elution with an acidified sodium chloride solution was studied. The effects of the number of sections, section heights, amount of resin withdrawal, and solution flow rates were investigated. Also examined were the kinetic and equilibrium relationships for the absorption step. The experimental data indicate a strong interdependence between variables. Solution retention time appears to be a major limiting variable. The column was efficient over a range of conditions, but close control was needed for optimum operation.

26205 Leaching of primary sulfide ores in sulfuric acid solutions at elevated temperatures and pressures. Leach, D.L.; Braun, R.L. (Univ. of California, Livermore). *Trans. Soc. Min. Eng. AIME;* **260**: No. 1, 41-49(Mar 1976).

From AIME annual meeting; New York, NY (Feb 1976).

Laboratory experiments simulating in-situ copper recovery from primary sulfide ores in sulfuric acid systems pressurized with oxygen are reported. Copper extraction and acid consumption data are correlated with temperature in the range 50 to 150°C and quenched pH in the range 0.25 to 2. Adverse changes in the chemical composition of the leach solution and the formation of gangue-mineral alteration products and secondary sulfides can severely limit the extraction of copper above 90°C. Keeping the pH below the self-buffered value of about 2 and the temperature below about 110°C produces the maximum extraction rates. Forcing the pH too low not only results in excessively high acid consumption but may also limit the extraction of copper at temperatures above 100°C.

INORGANIC AND PHYSICAL CHEMISTRY

REFER ALSO TO CITATION(S) 26219, 26220

26206 (CONF-760651—(Absts.)) **Thirty-first symposium on molecular spectroscopy, Columbus, Ohio, June 14—18, 1976. Abstracts.** (Ohio State Univ., Columbus (USA). Dept. of Physics). 1976. 218p. National Science Foundation, Washington, DC.

From 31. symposium on molecular spectroscopy; Columbus, Ohio, United States of America (USA) (14 Jun 1976).

Abstracts of the papers presented at the thirty-first symposium on molecular spectroscopy are presented. (LK)

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 25217, 25225, 26161, 26198, 26458, 26459

26207 (BNL—21470) **Neutron diffraction studies of transition metal hydride complexes.** Koetzle, T.F.; Bau, R. (Brookhaven National Lab., Upton, N.Y. (USA); University of Southern California, Los Angeles (USA). Dept. of Chemistry). 1976. Contract E(30-1)-16. 10p. (CONF-760601—6). Dep. NTIS $3.50.

From Conference on neutron scattering; Gatlinburg, Tennessee, United States of America (USA) (6 Jun 1976).

Investigations of $H_3Ta(C_5H_5)_2$ (III), $HW_2(CO)_8(NO)$ (IV), and $HW_2(CO)_8(NO)$ $(P(OCH_3)_3)$ (V) have been completed. Preliminary results are available for $HFeCo_3(CO)_9[P(OCH_3)_3]_3$ (VII). This work, together with studies of $HMo_2(C_5H_5)_2(CO)_4$ $(P(CH_3)_2$,vi. and [(C H λ N] ?HCr (CO) ,, carried out at Argonne has led to some general observations on the geometry and the nature of bonding in these compounds. For example, in the structures of IV and V, both of which have bent W—H—W linkages (less than W—H—W in the range 125-130°), there is conclusive evidence for the existence of a closed three-center W—H—W bond with significant metal-metal interaction. Such is the case, because extensions of the axial W—C and W—N bonds trans to the hydride intersect at a point near the center of the W—H—W triangle. The geometry of VI, which also contains a bent M—H—M bond, is consistent with that of IV and V. Bridging M—H bonds in these second- and third-row hydrides range in length from 1.85 to 1.89 A, compared to 1.75 A in the first-row polynuclear complex VII. For metals of corresponding rows, bridging M—H bonds are about 0.1 A longer than terminal bonds, which are classified as single covalent bonds.

26208 (CONF-760503—5) **Solution behavior of hydrogen isotopes and other non-metallic elements in liquid lithium.** Maroni, V.A.; Calaway, W.F.; Veleckis, E.; Yonco, R.M. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-Eng-38. 10p. Dep. NTIS $3.50.

From International conference on liquified metal technology in energy production; Champion, Pennsylvania, United States of America (USA) (3 May 1976).

Results of experimental studies to measure selected thermodynamic properties for systems of lithium with non-metallic elements are reported. Investigations of the Li-H, Li-D, and Li-T systems have led to the elucidation of the dilute solution behavior and the H/D/T isotope effects. In the case of the Li-H and Li-D systems, the principal features of the respective phase diagrams have been delineated. The solubility of Li-D in liquid lithium has been measured down to 200°C. The solubility of Li_3N in liquid lithium and the thermal decomposition of Li_3N have also been studied. From these data, the free energy of formation of Li_3N and the Sieverts' constant for dissolution of nitrogen in lithium have been determined. Based on studies of the distribution of non-metallic elements between liquid lithium and selected molten salts, it appears that molten salt extraction offers promise as a means of removing these impurity elements (e.g., H, D, T, O, N, C) from liquid lithium.

26209 (GEPP—211) **Characterization of calcium chromate.** Welbon, W.W.; Antepenko, R. (General Electric Co., St. Peter-

sburg, Fla. (USA). Neutron Devices Dept.). 28 May 1976. Contract E(29;2)-656. 50p. Dep. NTIS $4.00.

Technical grade calcium chromate is used in a thermal cell as an active cathode material. The specified purity is greater than 96 percent calcium chromate. To obtain uniform and reproducible material, the chemical and physical properties of the calcium chromate needed to be determined. Initially, eight calcium chromate samples were characterized by 15 different chemical and physical tests. From the test results, it was determined that calcium chromate could be adequately characterized by seven tests: (1) percent calcium, (2) percent chromate, (3) titration of free hydroxide, (4) optical spectrographic analysis for metals, (5) loss on heating to 600°C as water, (6) particle size distribution, and (7) surface area measurement. Three calcium chromate samples have been characterized by the above seven tests.

26210 (LBL—4543) **Crossed beam studies of endoergic bimolecular reactions: production of stable trihalogen radicals.** Valentini, J.J.; Coggiola, M.J.; Lee, Y.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1976. Contract W-7405-ENG-48. 36p. (CONF-760901—1). Dep. NTIS $4.00.

From Faraday discussion on potential energy surfaces; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (8 Sep 1976).

The trihalogens IIF and ClIF and the pseudo-trihalogen HIF were directly observed as the products of the endoergic bimolecular reactions of F_2 with I_2, ICl, and HI in a crossed molecular beam experiment. At high collision energies, a second reactive channel producing IF becomes important. Product angular and velocity distributions show that this IF does not result from a four-center exchange reaction. Observed threshold energies for the formation of IIF, ClIF, and HIF yield lower bounds on the stability of these molecules (with respect to the separated atoms) of 69, 81, and 96 kcal/mole, respectively. Analysis of the product center-of-mass angular distributions indicate that a slightly nonlinear approach is most effective in bringing about reaction to form the stable triatomic radical. These studies reveal a potentially important mechanism for the $F_2 + I_2$ yields 2IF bulk gas phase reaction. 12 figs.

26211 (LBL—4978) **Absolute structure determination using electron microscopy.** Van der Biest, O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1976. Contract W-7405-ENG-48. 4p. (CONF-760803—8). Dep. NTIS $3.50.

From 34. Electron Microscopy Society of America annual meeting; Miami Beach, Florida, United States of America (USA) (9 Aug 1976).

Two enantiomorphs existing within a sample can be identified in an electron microscope by imaging in dark field in a multi-beam orientation. For a thick wedge-shaped $LiFe_5O_8$ crystal with an inversion boundary running through it, thickness fringe profiles were calculated and used to identify the structures on either side of the boundary. (DLC)

26212 (NU—2512-8) **Liquid—liquid surface impaction. Technical progress report, January 1, 1976—March 31, 1976.** Bankoff, S.G. (Northwestern Univ., Evanston, Ill. (USA). Technological Inst.). 1976. Contract AT(11-1)-2512. 12p. Dep. NTIS $3.50.

A discussion is presented of completed research on vapor explosions from dropping single drops of a liquid onto the surface of a second liquid. Liquids used include pentane, Freon-22, Woods metal, water, tin, etc. Mechanisms are discussed and proposed new experiments are described. (DLC)

26213 (ORO—1797-64) **NMR study of structure of lanthanide complexes in solution.** Choppin, G.R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1976. Contract E(40-1)-1797. 5p. (CONF-760916—1). Dep. NTIS $3.50.

From 3. international symposium on specific interactions between molecules or ions; Karpacz, Poland (20 Sep 1976).

The diagnostic value PMR studies of diamagnetic lanthanide complexes to define the nature of the species in the lanthanide-pyruvate system is discussed. The use of NMR spectra of both diamagnetic and paramagnetic lanthanide complexes to obtain detailed structural information is reviewed. (LK)

26214 (ORNL-tr—4199) **Properties of yttrium and scandium basic salts.** Mal'kevich, N.V.; Grishin, I.A. Translated by M. Gerrard from *Uch. Zap. Gor'k. Gos. Univ.*; No. 105, 34-38(1970). 3p. Dep. NTIS $3.50.

Thermographic and x-ray phase analysis methods were used to study the basic salts $Sc(OH)_{2\text{-}32}(SO_4)_{0\text{-}34}$, $y(OH)_2(SO_4)_{0\text{-}3}$, $y(OH)_{2\text{-}6}Clb'0_{\text{-}4}$, and $y(OH)_{2\text{-}6}(NO_3)_{0\text{-}4}$, schemes for their thermal decay are presented. It is noted that the basic salts have a weak crystalline structure.

26215 **Hydrated proton $H^+(H_2O)$/sub n/. IV. A high-precision neutron diffraction study of the diaquohydrogen ion, $(H_2O.H.OH_2)^+$, in trans-dichlorobis(ethylenediamine)cobalt(III) chloride hydrochloride dihydrate.** Roziere, J.; Williams, J.M. (Argonne National Lab., IL). *Inorg. Chem.*; **15**: No. 5, 1174-1178(May 1976).

The crystal structure of trans-dichlorobis(ethylenediamine)cobalt(III) chloride hydrochloride dihydrate has been determined from three-dimensional single-crystal neutron diffraction data. The crystals are monoclinic, space group $P2_1/c$, with two formula units in the unit cell of dimensions a = 10.682 (7) A, b = 7.883 (5) A, c = 9.075 (6) A, and β = 110.59 (4)°. A total of 5488 reflections were averaged yielding 2183 independent data and a full-matrix least-squares refinement based on F_o^2 gave a final $R(F_o^2)$ value of 0.077. The structure consists of trans-$[Co(en)_2Cl_2]^+$, Cl^-, and H_5O_2+ ions. The diaquohydrogen ion, $(H_2O.H.OH_2)+$, has the trans configuration. Analysis of the thermal motion of the bridging hydrogen atom of H_5O_2+ indicates that it moves in a broad, flat, anharmonic, single-minimum potential energy well.

26216 **Hydrogen evolving systems. I. The formation of H_2 from aqueous suspensions of $Fe(OH)_2$ and reactions with reducible substrates, including molecular nitrogen.** Schrauzer, G.N.; Guth, T.D. (Univ. of Califonia, San Diego). *J. Am. Chem. Soc.*; **98**: No. 12, 3508-3513(9 Jun 1976).

The evolution of hydrogen from mildly alkaline suspensions of $Fe(OH)_2$ appears to involve elemental iron as the intermediate, which is generated by way of a base-induced disproportionation of $Fe(OH)_2$. The disproportionation reaction also occurs in strongly alkaline suspensions of $Fe(OH)_2$; under these conditions H_2 is not formed and elemental iron accumulates in the precipitates instead. Disordered modifications of $Fe(OH)_2$ seem to exist which undergo disproportionation preferentially. The reactive modifications of $Fe(OH)_2$ are formed in higher relative concentrations or are stabilized by weak complexing or dispersing agents such as sugars and polyhydric alcohols, as well as to some extent by $Mg(OH)_2$ or glycine. The disproportionation of $Fe(OH)_2$ is significantly stimulated by ultraviolet light, as evidenced by the increased yields of H_2 in uv-light exposed samples. The evolution of H_2 is also stimulated by coprecipitation of $Fe(OH)_2$ with $Ni(OH)_2$. A variety of reducible substrates, e.g., C_2H_2, C_2H_4, CO, and N_2, act as inhibitors of H_2 formation. Reduction of these substrates occurs in a manner typical of reactions with highly dispersed elemental iron. With molecular nitrogen, hydrazine and ammonia are formed; both products were identified by specific colorimetric tests as well as by using $^{30}N_2$-enriched nitrogen as the substrate and subsequent mass-spectrographic analysis.

26217 **Quantitative metal-ligand bond dissociation energies in the gas phase by ion cyclotron resonance spectroscopy.** Corderman, R.R.; Beauchamp, J.L. (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.*; **98**: No. 13, 3998-4000(23 Jun 1976).

Ion cyclotron resonance spectroscopy was used to study the binding energies of 30 n-donor ligands to the cyclopentadienyl nickel cation, (eta^5 — C_5H_5) Ni^+. The gas phase ligand binding energies and proton affinities relative to NH_3 for the 30 n-donor bases were tabulated. The experimental methodology was described; and the trends in binding energy and correlation of binding energy to the previously determined proton affinities were discussed. (DDA)

26218 **Alleged existence of partially oxidized $Mg[Pt(CN)_4]Cl_0$ $2R7H_2O$ and the attempted preparation of the analogous Be^{2+} and Ba^{2+} derivatives. A caveat.** Koch, T.R.; Gebert, E.; Williams, J.M. (Argonne National Lab., IL). *J. Am. Chem. Soc.*; **98**: No. 13, 4017-4018(23 Jun 1976).

Attempts to synthesize and characterize partially oxidized tetracyanoplatinate salts containing a divalent cation, Mg, Be, or Ba, proved unsuccessful. Contrary to previous reports, the product of the magnesium reaction was found to be a hydrate of $Mg[Pt(CN)_4].7H_2$ by the use of chemical analysis, x-ray fluorescence, and powder x-ray diffraction. (DDA)

ISOTOPE EFFECTS

26219 **Vibrational frequency shifts for isotopes of hexacarbonylchromium.** Jones, L.H. (Los Alamos Scientific Lab., NM). *Inorg. Chem.*; **15**: No. 5, 1244-1245(May 1976).

Carbonyl stretching frequencies and calculated force constants for some isotopic species of $Cr(CO)_6$ in CCl_4 solution are tabulated. It is pointed out that force constants calculated from the stretching frequencies for ^{13}C-substituted species are useful for assigning isotopic frequency shifts for the ^{13}C isotope alone, but frequencies for the ^{18}O isotopic shifts show that there are serious limitations to the CO-factored force field. (BLM)

26220 Carbon-13 isotopic exchange in pentacarbonyliron. Mahnke, H.; Sheline, R.K. (Florida State Univ., Tallahassee). Contract E(40i1)-2434. *Inorg. Chem.*; **15**: No. 5, 1245-1246(May 1976).

Previous nonclusive experimental results to answer the question of intra- vs intermolecular exchange in $Fe(CO)_5$ are surveyed. Results of experiments using 92 percent enriched $Fe(^{13}CO)_5$ and $Fe(^{13}CO)_5$ with only natural abundance of ^{13}C are described. The spectral data indicated that the intermolecular exchange is very slow without a catalyst to definitely prove that the CO ligand exchange between axial and equatorial positions follows an intra- rather than an intermolecular path. The high contribution of spin-rotation interaction to the relaxation mechanism is also cited as evidence of an intramolecular exchange path. (BLM)

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 25400

26221 (COO—2724-1) **Laser isotope separation by selective excited state photochemistry. Progress report, June 1, 1975—February 29, 1976.** Zare, R.N. (Columbia Univ., New York (USA). Dept. of Chemistry). Feb 1976. Contract E(11-1)-2724. 15p. Dep. NTIS $3.50.

Progress has been made on the development of a low-temperature source for the generation of uranium atoms, and the use of laser-induced predissociation in Rb_2* for isotope separation. However, our main efforts have concentrated on understanding and improving the laser isotope separation of ^{35}Cl and ^{37}Cl by photochemical means. The gas-phase reaction ICl* with 1,2-dibromoethylene produces both cis-1-bromo-2-chloroethylene and cis-1,2-dichloroethylene stereospecifically. Selective excitation of $I^{37}Cl$ with a tunable cw dye laser causes identical degrees of isotope enrichment in both products. By the use of an $I^{35}Cl$ cell placed inside the cavity of the dye laser, the ^{35}Cl:^{37}Cl ratio may be changed from 3:1 (natural abundance) to greater than 1:15. A competing pathway, cis-trans isomerization of starting material, also occurs and is the fastest reaction. The stereospecificity of the reaction and the relative rate of geometrical isomerization to substitution are the same when chlorine atoms, formed by the photodissociation of ICl or Cl_2, are scavenged by dibromoethylene. We conclude that, kinetically, ICl* acts as a free chlorine atom. That isotope separation is achieved by a free-radical scavenging mechanism is indeed remarkable and owes its success to the structure of the scavenger and the choice of initial conditions.

26222 (K-GD—1479) **Prediction of separation of gases and gaseous isotopes in a curved shock wave.** Tunstall, J.N.; Harris, W.L.; Childs, K.W. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 1976. Contract W-7405-eng-26. 27p. (CONF-760710—2). Dep. NTIS $4.00.

From 10. international symposium on rarefied gas dynamics; Aspen, Colorado, United States of America (USA) (18 Jul 1976).

An examination of the species separation induced by a curved shock wave in a supersonic flow of a binary gas mixture has been undertaken. The objectives of this investigation are to determine the importance of physical mechanisms operative in such flows per the species separation and to develop a self-consistent model for predicting species separation in such flows. The formulation of the model examined in this paper is based on the continuum Navier-Stokes equations. The effects of a specified flow field downstream of the shock have been neglected. The parameters which characterize the separation induced by the shock have been identified. Results show a mathematically self-consistent and physically plausible dependence on the parameters which characterize the phenomenon. A comparison with existing theoretical models and experimental data shows good agreement.

26223 (MLM—2331(OP)) **Experimental determination of reaction rates of water. Hydrogen exchange of tritium with hydrophobic catalysts.** Bixel, J.C.; Hartzell, B.W.; Park, W.K. (Mound Lab., Miamisburg, Ohio (USA)). 1976. Contract E-33-1-GEN-53. 9p. (CONF-760822—10). Dep. NTIS $3.50.

From 14. US ERDA air cleaning conference; Sun Valley, Idaho, United States of America (USA) (2 Aug 1976).

This study was undertaken to obtain data needed for further development of a process for the enrichment and removal of tritium from the water associated with light-water reactors, fuel-reprocessing plants, and tritium-handling laboratories. The approach is based on the use of antiwetting, hydrophobic catalysts which permit the chemical exchange reactions between liquid water and gaseous hydrogen in direct contact, thus eliminating problems of catalyst deactivation and the complexity of reactor design normally associated with current catalytic-detritiation techniques involving gas-phase catalysis. An apparatus and procedure were developed for measuring reaction rates of water-hydrogen chemical exchange with hydrophobic catalysts. Preliminary economic evaluations of the process were made as it might apply to the AGNS fuel reprocessing plant.

ORGANIC CHEMISTRY

REFER ALSO TO CITATION(S) 25226, 25523

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 25225, 25522, 26197, 26198, 26212, 26217, 26234

26224 Cyclobuta[1,2-d]benzyne. Generation, trapping, and dimerization to 2,3:6,7-dicyclobutabiphenylene. Hillard, R.L. III; Vollhardt, K.P.C. (Univ. of California, Berkeley). *J. Am. Chem. Soc.*; **98**: No. 12, 3579-3582(9 Jun 1976).

Cyclobuta[1,2-d]benzyne has been generated from 4,5-bromoiodobenzocyclobutene and magnesium or butyllithium. The transient reactive species can be trapped with furan as the Diels—Alder adduct. In the absence of trapping agents dimerization occurs to 2,3:6,7-dicyclobutabiphenylene, a novel strained benzenoid hydrocarbon with distinctly olefinic properties.

26225 Triplet state of chlorophylls. Clarke, R.H.; Connors, R.E.; Schaafsma, T.J.; Kleibeuker, J.F.; Platenkamp, R.J. (Univ. of Boston). *J. Am. Chem. Soc.*; **98**: No. 12, 3674-3677(9 Jun 1976).

The triplet state zero-field splittings and rates of intersystem crossing for the individual triplet spin sublevels in chlorophyll a, chlorophyll b, and zinc-substituted chlorophylls are presented. Whereas there are only small differences in zero-field splitting parameters among the chlorophylls, their kinetics show significant differences. The general trends in the chlorophyll intersystem crossing rate constants of the triplet spin sublevels may be explained qualitatively by a consideration of the one-center spin—orbit and spin—vibronic coupling activity of the chlorophyll ring system and the effect of side-chain substituents on these coupling mechanisms.

26226 Tetramethylsilacyclopropene. Conlin, R.T.; Gaspar, P.P. (Washington Univ., St. Louis). *J. Am. Chem. Soc.*; **98**: No. 12, 3715-3716(9 Jun 1976).

Tetramethylsilacyclopropene was obtained as an additional product of dimethylsilylene $(CH_3)_2Si$ and 2-butyne and was observed to be stable for weeks at room temperature in the absence of air. The compound was destroyed within a minute when exposed to the laboratory atmosphere, and while it appeared stable at 75°C, it decomposed within an hour at 105°C. NMR and Mass Spectra were used to identify and characterize the compound. (DDA)

26227 Synthesis and binding characteristics of macrocyclic polyethers containing convergent methoxyaryl or phenolic groups. Koenig, K.E.; Helgeson, R.C.; Cram, D.J. (Univ. of California, Los Angeles). *J. Am. Chem. Soc.*; **98**: No. 13, 4018-4020(23 Jun 1976).

The synthesis and ion-binding properties were reported for 11 new macrocyclic polyethers containing one or two ArOH or $ArOCH_3$ groups whose oxygens when complexed lie above or below the best plane of the macroring. Approximate association constants of the macrocyclic polyethers and their picrate salts in $CHCl_3$ at 25° were tabulated. (DDA)

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

26228 (UCID—17136) **Reclaiming process for scrap deuterated polyethylene (CD_2).** Caley, L.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 May 1976. Contract W-7405-Eng-48. 6p. Dep. NTIS $3.50.

A laboratory version of a process to clean contaminated deuterated polyethylene (CD_2) was modified slightly and scaled up to produce 2 lb of clean, reusable CD_2 polymer. A complete cycle of the process is: (1) Melt the CD_2 polymer at 30 vol percent in xylene at 105 to 110°C. (2) Pressure filter the hot solution at 103 to 138 kPa (15 to 20 psi). (3) Cool the solution to precipitate the polymer and separate it from the liquor. (4) Vacuum dry the precipitate at about 266 Pa and 37°C.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 26231

26229 (LA-UR—76-727) **$SO_2(^3B_1)$ photosensitized isomerization of cis and trans-1,2-dichloroethylene.** Wampler, F.B.; Boettenheim, J.W. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 7p. (CONF-760620—3). Dep. NTIS $3.50.

From 12. informal conference on photochemistry; Gaithersburg, Maryland, United States of America (USA) (28 Jun 1976).

Lifetime measurements of $SO_2(^3B_1)$ molecules in the presence of cis and trans-1,2-dichloroethylene were made by using time resolved laser induced phosphorescence. Quantum yields for the SO_2 photosensitized isomerization of cis and trans-1,2-dichloroethylene were made. A kinetic treatment of the initial quantum yield data was consistent with the formation of a polarized charge-transfer intermediate whenever $SO_2(^3B_1)$ molecules and one of the 1,2-dichloroethylene isomers collide which ultimately decays unimolecularly to the cis isomer with a probability of 0.70 +- 0.26 and to the trans isomer with a 0.37 +- 0.16 probability. (LK)

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 25857, 26198

26230 (ANL—75-62) **Improved TV-scanning method for recording time-resolved optical spectra of transients.** Schmidt, K.H.; Gordon, S.; Mulac, W.A. (Argonne National Lab., Ill. (USA)). Mar 1976. Contract W-31-109-Eng-38. 27p. Dep. NTIS $4.00.

An improved method to record a time-resolved transient absorption or emission spectrum produced by a single pulse of radiation is described. A streak image of the spectrum is produced by an image-converter camera. The image is scanned by a TV camera, stored in a video-disk recorder, and transferred line by line to a computer. The computer can produce three-dimensional plots of absorbance or emission versus time and wavelength containing 100 x 100 data points. 19 figs.

26231 (COO—3028-24) **Measured yields of CO in the radiolysis and photolysis of CO_2.** Fish, J.D. (Puerto Rico Water Resources Authority, San Juan). Jul 1976. Contract E(11-1)-3028. 13p. Dep. NTIS $3.50.

This survey of the recent literature is addressed to the proposition that the copious fluxes of high grade radiation from a fusion reactor can be used to decompose carbon dioxide. The carbon monoxide and oxygen produced in such a scheme can be separated, the oxygen sold as a valuable by-product, and the carbon monoxide shifted with water to yield hydrogen, the panacea of fuels. Both radiolysis and photolysis of CO_2 are considered, as well as work by two groups which suggests an important connection between these two areas. In particular, the development of a method of predicting G values theoretically is discussed.

26232 (ORO—3106-60) **Radiation chemistry of hydrocarbon and alkyl halide systems. Progress report, August 1, 1975—June 30, 1976.** Hanrahan, R.J. (Florida Univ., Gainesville (USA)). 1976. Contract E(40-1)-3106. 27p. Dep. NTIS $4.00.

Radiolysis studies of CF_3I and C_2F_5I were completed as well as a study of the high pressure mass spectrometry of CF_3I using the time-of-flight mass spectrometer. Studies on the photochemistry, radiation chemistry, and mass spectrometry of 1,1,2,2-tetrafluorocyclobutane were completed and are summarized. Work in the area of gas phase radiolysis of chlorofluorocarbons was concentrated on product identification and yield measurements in CF_2Cl_2. (LK)

26233 **ESR of x-irradiated single crystals of 3'-cytidylic acid: hydrogen abstraction from C/sub 5'/ of the sugar moiety.** Bernhard, W.A. (Univ. of Rochester School of Medicine and Dentistry, NY); Corelli, J.C. *Radiat. Res.*; **66**: No. 1, 19-32(Apr 1976).

The dominant free radical trapped in x-irradiated single crystals of 3'-cytidylic acid at 77°K was identified as HOC/sub 5'/(H)C/sub 4'/(H) <. For this radical the g-tensor and hyperfine coupling tensors for the α-hydrogen and two β-hydrogens were determined. An unusually large isotropic coupling (21 G) to the hydroxyl hydrogen is observed as a result of the O-H bond being constrained so as to give a very small torsion angle with the lone electron p-orbital axis. Crystals grown from D_2O give a collapsed spectrum where the hydroxyl splitting is reduced by a factor of 1/6.5. On warming to approximately 290°K the HOC/sub 5'/(H)C/sub 4'/(H) < radical deprotonates yielding the primary room temperature radical -OC/sub 5'/(H)C/sub 4'/(H) <. A reorientation of approximately 40° is postulated to account for the observed directions of the hyperfine and g-tensor axes determined for the room-temperature radical.

26234 **Conversion of hydroxyphenyl to phenoxyl radicals: a radiolytic study of the reduction of bromophenols in aqueous solution.** Schuler, R.H.; Neta, P.; Zemel, H.; Fessenden, R.W. (Carnegie-Mellon Univ., Pittsburgh). *J. Am. Chem. Soc.*; **98**: No. 13, 3825-3831(23 Jun 1976).

Both steady-state ESR and spin trapping experiments demonstrate that hydroxyphenyl radicals are produced in the reaction of hydrated electrons with the bromophenols. Conductometric and optical pulse radiolysis studies show that the anionic forms of the ortho and para hydroxyphenyl radicals protonate rapidly at the radical site to produce phenoxyl radical. At pH 11.5 the protonation periods are respectively 14 and 4.1 μs. The meta isomer protonates at least an order of magnitude more slowly. Protonation is not observed for the neutral forms of these radicals. The important feature required for protonation appears to be the existence of appreciable negative charge density at the radical site. The rapid protonation of the p-hydroxyphenyl radical anion observed here provides a reference with which to compare other reactions of this radical and it has been possible to estimate a rate constant of 6 x 10^5 M^{-1} s^{-1} for its abstraction of H from tert-butyl alcohol and 4 x 10^7 M^{-1} s^{-1} for its addition to nitromethane. In the case of p-bromophenol, the phenoxyl radicals resulting from the initial protonation undergo a tertiary electron transfer reaction with p-bromophenoxide with a rate constant of 2.0 x 10^8 M^{-1} s^{-1}, so that the optical absorption spectra of the three bromophenoxyl radicals produced by OH reactions were also examined and are reported here. Because of this tertiary transfer, phenoxyl radicals cannot be observed in steady-state ESR experiments on these systems. Studies of the dependence of the width of the ESR lines of phenoxyl radical produced from phenol on the phenol concentration show that electron transfer between the radical and the substrate occurs with a rate constant of 1.9 x 10^8 M^{-1} s^{-1}.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

HOT-ATOM CHEMISTRY

REFER ALSO TO CITATION(S) 26133

26235 **Positronium and muonium chemistry.** Ache, H.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). pp 81-105 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

This report briefly examines the present status of the chemistry of two new atoms, positronium and muonium. The current or future contributions which the study of these new atoms can make towards our understanding of the fundamental aspects of chemical dynamics in general, and more specifically towards the problems involved in hot atom chemistry, are discussed.

26236 **Physical methods in hot atom chemistry.** Adloff, J.P. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. de Chimie Nucleaire). pp 61-76 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

Physical methods have found considerable use in the field of hot atom chemistry. Methods that have found the greatest use in the past or are used to generate hot species are briefly mentioned, while those which are either relatively unexplored or are used for the in-situ analysis of the chemical state of atoms in solids, are discussed in some detail. These include hyperfine interactions, Moessbauer spectroscopy, perturbed angular correlations, alteration of nuclear decay rates by chemical environmental influence, nuclear resonance fluorescence, and optical excitation in beta decay.

26237 **Fission recoil chemistry.** Amiel, S. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center); Alfassi, Z.B. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Nuclear Sciences). pp 265-269 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

A review is given of the available information on chemical reactions of fission recoil in gaseous and in condensed phases.

26238 Chemical effects of the reaction ^{129}I (n, γ) sup(130m, 130)I in presence of butane. Behzadi, K. (National Iranian Oil Co., Teheran). *Bull. Iran. Pet. Inst.*; No. 58, 18-26(1975).

18 refs., graphs, with an Iranian abstract p. 29.

Organic yield of iodine from ^{129}I neutron capture reaction in gaseous mixture of I and C_4H_{10} was studied. Evolution of the total organic yield of ^{130}I was examined in relation to molar fraction of I; determining thermal processes and also in relation to molar fraction of rare gases for characterization of hot reactions. Experiments were performed at constant butane pressure and variable molar fraction of I_2, and at fixed amount of iodine (10^{-6}mole). The results were identical for sup(130m)I and ^{130}I indicating the absence of an isomeric effect, the fraction of total organic yield due to the radiolytic mechanisms was evaluated by means of radioactive ^{131}I traser. The moderation role of Iodide is negligible for the value of molar fraction of the iodine used. Results of the evolution organic yield as a function of molar fraction of rare gases (Ar, Kr, Xe) were comparable to those obtained by Lagarde et al. for ^{128}I. Replacement of the increasing amount of butane by a rare gas, causes an increase in molar fraction of I. Radicalar reactions influenced greatly by the molar fraction of iodine, are predominant in iodine concentrations, lower than 5.10^{-3}. Reactions attributed to iodine ions, which are less sensitive to the presence of iodine are more dependent on the pressure of Kr and Xe.

26239 Role of nuclear techniques in the study of gas-phase ionic reactions. Cacace, F. (Rome Univ. (Italy)). pp 229-239 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

A critical review of the theory, the applications and the role of the nuclear approach to the chemistry of gaseous ion^{+} is presented. Topics dealt with include methods of investigations of ionic reactions in the gas phase, studies involving decay of tritium and carbon-14-labelled molecules and formations of radioactive halogen ions from nuclear transformations. Lines of future development in this field are suggested.

26240 Hot atom chemistry in inorganic solids. Harbottle, G. (Brookhaven National Lab., Upton, N.Y. (USA)). pp 19-24 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

This paper examines the present status and notes possible future directions in the hot atom chemistry of solids. This area of activity is briefly defined and the theoretical and experimental knowledge that at present exists, or is lacking, is discussed. Suggestions for future work are offered.

26241 Role of atomic beams in hot atom chemistry. Lee, Y. (Chicago Univ., Ill. (USA). Dept. of Chemistry). pp 123-131 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

Many experimental techniques exist which can provide experimental data needed to understand the dynamics of a chemical reaction. These are briefly identified with some of the limitations suggested. The present status of the investigation of the chemical reactions of energetic atoms by the crossed nuclear beam method is reviewed in detail. Anticipated future developments and fruitful areas of research are identified.

26242 Accelerators and nuclear reactors as tools in hot atom chemistry. Lindner, L. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). pp 1-10 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

The characteristics of accelerators and of nuclear reactors, the latter to a lesser extent, are discussed in view of their present and future use in hot atom chemistry research and its applications.

26243 Impact of theoretical chemistry on elucidation of hot atom reaction mechanisms. Newton, M.D. (Brookhaven National Lab., Upton, N.Y. (USA)). pp 107-114 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

The current impact of the various areas of theoretical chemistry is briefly examined with regard to the elucidation of hot atom reaction mechanisms. The particular relationship between theory and experiment and improved understanding of energy transfer and chemical kinetics is discussed from the point of view of the theorists with some emphasis on the experimental contributions to improving theoretical understanding and testing theoretical models. Applications of modern theory to hot atom chemistry are suggested.

26244 Gas phase reactions of atomic tritium, fluorine and chlorine. Rowland, F.S. (California Univ., Irvine (USA). Dept. of Chemistry). pp 139-148 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

Experimental studies of hot atom gas phase reactions involving atomic tritium, fluorine and chlorine have contributed significantly to an increased understanding of chemical kinetics. This paper considers the formation of hot atoms in the gas phase, the determination of reaction products and inference of kinetic mechanisms, and the basic hot reactions in monovalent systems. Also discussed are stereochemistry in the gas phase, bond energy effects, thresholds for atomic reactions, excitation energy of the products and substituent influences on primary substitution yields as determined through studies on tritium, fluorine or chlorine systems.

26245 Hot atom chemistry of inorganic liquid systems. Saito, N.; Tominaga, T. (Tokyo Univ. (Japan). Faculty of Science). pp 191-199 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

The hot atom chemistry of the liquid system tris(acetylacetonato)cobalt in a benzene solution has been studied and the results presented. The use of metal salts as scavengers to suppress thermal reactions in irradiated systems is discussed. Several different parameters were studied to determine their effects on the reactions under study and the results are described.

26246 Beta decay and isomeric transition. Shiokawa, T. (Tohoku Univ., Sendai (Japan)). pp 241-252 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

Hot atoms produced by beta decay and isomeric transition can be effectively utilized to study their chemical effects. Experimental procedures, including methods of analysis, employing hot atoms produced in these ways, are presented and work that has been carried out in the gas phase, in the liquid phase, and in the solid phase, is discussed in some detail.

26247 Hot atom chemistry of monovalent atoms in organic condensed phases. Stoecklin, G. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Nuklearchemie). pp 161-181 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

The advantages and disadvantages of hot atom studies in condensed organic phases are considered, and recent advances in condensed phase organic hot atom chemistry of recoil tritium and halogen atoms are discussed. Details are presented of the present status and understanding of liquid phase hot atom chemistry and also that of organic solids. The consequences of the Auger effect in condensed organic systems are also considered.

26248 Applied hot atom chemistry, labelling of compounds, and isotope production. Wolf, A.P. (Brookhaven National Lab., Upton, N.Y. (USA)). pp 271-275 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

The general aspects of applied problems which can be of concern to the hot atom chemist are presented. The preparation of labelled radiopharmaceuticals is discussed with some emphasis given to the production of radionuclides as well as the chemistry of labelling. Other applications, including preparation of organometallics and complexes of all types and also analytical control applications, are discussed.

26249 Problems of isolated scientists or research groups. Lima, F.W. (Instituto de Energia Atomica, Sao Paulo (Brazil)). pp 317-321 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

In examining the role of hot atom chemistry in the Agency, specific questions dealing with the problems of isolated scientists or research groups, the various mechanisms for technical assistance to developing countries were raised. This working paper identifies some of the key issues and serves as a basis for discussion and recommendations for the Agency's programmes.

26250 Molecular activation analysis. Grant, P.M.; Rowland, F.S. (California Univ., Irvine (USA). Dept. of Chemistry). pp 219-222 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

The process of neutron activation potentially carries with it information concerning the "site" of the original reacting atom because the newly created radioactive nuclide is formed at the physical location and in the chemical surroundings of the original atom. Circumstances under which this displaced atom can be used to identify the original elemental location or the original molecular compound in which the activated element had been bound, are discussed with several examples presented.

26251 Hot atom chemistry of carbon. Wolf, A.P. (Brookhaven National Lab., Upton, N.Y. (USA)). pp 203-209 of In Hot atom chemistry status report. Proceedings of a panel on the status of hot atom chemistry and its relation to other fields of science and technology organized by the IAEA held in Vienna, 13-17 May 1974. Vienna; IAEA (1975).

From Panel on the status of hot atom chemistry and its relation to other fields of science and technology; Vienna, Austria (13 May 1974).

The chemistry of energetic carbon atoms is discussed. The experimental approach to studies that have been carried out is described and the mechanistic framework of hot carbon atom reactions is considered in some detail. Finally, the direction that future work might take is examined, including the relationship of experimental to theoretical work.

26252 Effect of additives on the reaction of monomeric silicon difluoride with 1,3-butadiene. Zeck, O.F.; Su, Y.Y.; Gennaro, G.P.; Tang, Y.N. (Texas A and M Univ., College Station). *J. Am. Chem. Soc.*; **98**: No. 12, 3474-3477(9 Jun 1976).

Recoil ^{31}Si atom reactions with PF_3 resulted in the formation of both singlet and triplet $^{31}SiF_2$ in the ratio of 1.0:3.3. Singlet $^{31}SiF_2$ reacted with 1,3-butadiene to give difluorosilacyclopent-3-ene-^{31}Si, but triplet $^{31}SiF_2$ only gave this product in the presence of paramagnetic molecules such as NO, NO_2, or O_2.

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 25502, 26239, 26246, 26248

26253 (BNL—21307) **Positron emitting nuclides and their synthetic incorporation in radiopharmaceuticals.** Fowler, J.S. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 22p. (CONF-760455—1). Dep. NTIS $3.50.

From Symposium on chemistry of radiopharmaceuticals; Philadelphia, Pennsylvania, United States of America (USA) (23 Apr 1976).

^{11}C, ^{13}N, and ^{15}O has potential applicability to the study of metabolism in humans. Problems in the synthesis of radiopharmaceuticals labeled with ^{11}C, ^{13}N, and ^{18}F are described: quality control, radiation exposure, carboxylic acids, glucose, amines, amino acids, nitrosources, fluoroethanol. 54 references. (DLC)

26254 (BNL—21594) **Moessbauer spectroscopic investigation of radiation damage of Co(III)-HEDTA and Fe(III)-HEDTA complexes.** Nagy, A.G.; Dezsi, I.; Hillman, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 18p. (CONF-760662—1). Dep. NTIS $3.50.

From 4. symposium on radiation chemistry; Keszthely, Hungary (1 Jun 1976).

The chemical effect of the electron capture of ^{57}Co isotope in solid organic complexes was studied as a function of dimeric and monomeric structures of the same molecule as well as a function of the environment of the molecule in crystalline solid and frozen solutions of the same molecule. The ^{57}Co was prepared in the forms of CO(III)-HEDTA and Fe(III)-HEDTA. In crystalline ^{57}Co(III)-HEDTA dimer the daughter ^{57}Fe of two valency states was observed in the ratio 75 percent to 25 percent. Results of the study indicate that the stabilization of $^{57}Fe/sup\ n+/$ is influenced not only by the immediate environment of the decayed nuclei but also by the environment of the whole molecule. (LK)

26255 (DP-MS—75-119) **Characterization of oxalate-based $^{237}NpO_2$ powder.** Rankin, D.T.; Burney, G.A.; Smith, P.K.; Sisson, R.D. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1976. Contract AT(07-2)-1. 32p. (CONF-760532—3). Dep. NTIS $4.00.

From 78. annual meeting of the American Ceramic Society; Cincinnati, Ohio, United States of America (USA) (3 May 1976).

^{238}Pu, a radioisotope heat source, is produced by irradiating reactor targets containing $^{237}NpO_2$. The neptunium oxide is obtained by precipitating and calcining ^{237}Np(IV) oxalate. The effects of oxalate precipitation parameters on particle morphology and size distribution of $^{237}NpO_2$ powder were established to provide process controls for fabricating reactor targets.

26256 Fast gas-thermochromatographic separation of radioactive elements. Pt. 3. Production and thermochromatographic behaviour of volatile oxides and hydroxides of radioactive tungsten. Bayar, B.; Novgorodov, A.F.; Vocilka, I.; Zaitseva, N.G. (Joint Inst. for Nuclear Research, Dubna (USSR)). *Radiochem. Radioanal. Lett.*; **22**: No. 1, 53-62(1975).

6 figs.; 16 refs.; 2 tables.

High temperature < sublimation and thermochromatographic behaviour of ultramicro and micro amounts of radioactive tungsten in oxygen stream were investigated. Dependences on the partial pressure of water vapour in the carrier gas, on the rate of the carrier gas and on sublimation time were looked at. In wet oxygen W is transported predominantly in the form of $WO_2(OH)_2$. On the basis of the data obtained the fast gas-thermochromatographic method of separating radiochemically pure, carrier-free tungsten from Ta and Au targets irradiated with high-energy protons has been developed. The ultramicro amounts of tungsten were produced in nuclear reactions of Au(p;6p,xn)W where Esub(p)=660 meV and Ta(p;xn)W where Esub(p)=120 MeV by irradiating Au/0.1mm/ and Ta/0.1 mm/ foils. In order to investigate the behaviour of micro amounts of W a model mixture of 50 mg Ta_2O_5 and 50 μg $^{185}Wsub(met)$ was used. The distribution of ^{185}W along the column when using the Ta_2O_5+^{185}W model mixture was determined by moving the column in front of a collimated NaI/Tl/ /22 cm^3/ scintillation detector and the radioactivity was recorded on an automatic recorder.

26257 Ring-bridged biscyclopentadieneyluranium(IV) halides. Secaur, C.A. (Univ. of Nebraska, Lincoln); Day, V.W.; Ernst, R.D.; Kennelly, W.J.; Marks, T.J. *J. Am. Chem. Soc.*; **98**: No. 12, 3713-3715(9 Jun 1976).

A method was reported for synthesizing a series of highly stable biscyclopentadienyluranium(IV) halide systems. For the chloride compounds, anionic biscyclopentadienides containing a variable bridging group were reacted with uranium tetrachloride in tetrahydrofuran (-78°). Mass spectral, NMR and ir methods were used to study the molecular structure and chemical properties with special emphasis on $Li\ U_2Cl_5(CH_2(C_5H_4)_2)_2(OC_4H_8)_2$. (DDA)

RADIOISOTOPE PRODUCTION

REFER ALSO TO CITATION(S) 26076, 26248, 26256

26258 (BNL—21538) **Production of radionuclides ^{123}I, ^{77}Br for nuclear medicine with high energetic ^{4}He particles.** Helus, F.; Maier-Borst, W.; Lambrecht, R.M.; Wolf, A.P. (Brookhaven National Lab., Upton, N.Y. (USA); Deutsches Krebsforschungszentrum, Heidelberg (Germany, F.R.). Inst. fuer Nuklearmedizin). 1975. Contract E(30-1)-16. 12p. (CONF-750824—16). Dep. NTIS $3.50.

From 7. international conference on cyclotrons and their applications; Zurich, Switzerland (19 Aug 1975).

The feasibility of using 50-102 MeV alpha particles to produce the ^{123}Xe yields ^{123}I and ^{77}Kr yields ^{77}Br generators were evaluated using targets of natural sodium iodide and sodium bromide. Thick target yields of direct and indirect produced ^{123}I and ^{77}Br were measured. Production rates for other resulted radionuclides were also measured, and the level of indirectly produced ^{125}I impurity were determined.

COMBUSTION CHEMISTRY

REFER ALSO TO CITATION(S) 25298, 25300

26259 (N—75-20495) **Investigation of critical burning of fuel droplets. Annual report, 1974.** Faeth, G.M.; Chanin, S. (Pennsylvania State Univ., University Park (USA). Dept. of Mechanical Engineering). 1974. Contract NGR-39-009-077. 43p. (NASA-CR—134793). NTIS $3.75.

The steady combustion characteristics of droplets were considered in combustion chamber environments at various pressures, flow conditions, and ambient oxidizer concentrations for a number of hydrocarbon fuels. Using data obtained earlier, predicted gasification rates were within [or - 30% of measurements when the correction for convection was based upon average properties between the liquid surface and the flame around the droplet. Analysis was also completed for the open loop response of monopropellant droplets, based upon earlier strand combustion results. At the limit of large droplets, where the effect of flame curvature is small, the results suggest sufficient response to provide a viable mechanism for combustion instability in the frequency and droplet size range appropriate to practical combustors. Calculations are still in progress for a broader range of droplet sizes, including conditions where active combustion effects are small. (Author) (GRA)

26260 (UCRL—78026) **Ignition inhibitors for cellulosic materials.** Alvares, N.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Apr 1976. Contract W-7405-Eng-48. 7p. (CONF-760826—4). Dep. NTIS $3.50.

From American Chemical Society meeting; San Francisco, California, United States of America (USA) (29 Aug 1976).

By exposing samples to various irradiance levels from a calibrated thermal radiation source, the ignition responses of blackened alpha-cellulose and cotton cloth with and without fire-retardant additives were compared. Samples treated with retardant compounds which showed the most promise were then isothermally pyrolyzed in air for comparisons between the pyrolysis rates. Alpha-cellulose samples containing a mixture of boric acid, borax, and ammonium di-hydrogen phosphate could not be ignited by irradiances up to 4.0 cal cm^{-2} s-1 (16.7 W/cm^2). At higher irradiances the specimens ignited, but flaming lasted only until the flammable gases were depleted. Cotton cloth containing a polymeric retardant with the designation THPC + MM was found to be ignition-resistant to all irradiances below 7.0 cal cm^{-2} s^{-1} (29.3 W/cm^2). Comparison of the pyrolysis rates of the retardant-treated alpha-cellulose and the retardant-treated cotton showed that the retardant mechanism is qualitatively the same. Similar ignition-response measurements were also made with specimens exposed to ionizing radiation. It was observed that gamma radiation results in ignition retardance of cellulose, while irradiation by neutrons does not.

ENGINEERING

GENERAL ENGINEERING

26261 (UCRL—50016-76-1) **Mechanical Engineering Department quarterly report, January—March 1976.** Stone, R.G.; Barnett, J.M. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Mar 1976. Contract W-7405-Eng-48. 25p. Dep. NTIS $3.50.

A separate abstract was prepared for each of the four sections in the report. (TFD)

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 25803, 25871, 26362

26262 (BARC/I—335) **Design and performance of high pressure autoclaves.** Vaidya, S.N.; Kerkar, A.S. (Bhabha Atomic Research Centre, Bombay (India)). 1975. 3p. INIS.

1 table, 3 figures.

The design and development of two high pressure autoclaves are described. The autoclaves were fabricated for investigations of the behavior of materials at steam pressures and temperatures existing in a nuclear reactor, i.e., up to 140 bars and 600°K.

26263 (LA—6254-MS) **Computer-assisted estimating for the Los Alamos Scientific Laboratory.** Spooner, J.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1976. Contract W-7405-Eng-36. 15p. Dep. NTIS $3.50.

An analysis is made of the cost estimating system currently in use at the Los Alamos Scientific Laboratory (LASL) and the benefits of computer assistance are evaluated. A computer-assisted estimating system (CAE) is proposed for LASL. CAE can decrease turnaround and provide more flexible response to management requests for cost information and analyses. It can enhance value optimization at the design stage, improve cost control and change-order justification, and widen the use of cost information in the design process. CAE costs are not well defined at this time although they appear to break even with present operations. It is recommended that a CAE system description be submitted for contractor consideration and bid while LASL system development continues concurrently.

26264 (LA—6265-MS) **Development of coring, consolidating, subterrene penetrators.** Murphy, H.D.; Neudecker, J.W.; Cort, G.E.; Turner, W.C.; McFarland, R.D.; Griggs, J.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1976. Contract W-7405-eng-36. 19p. Dep. NTIS $3.50.

Coring penetrators offer two advantages over full face-melting penetrators, i.e., formation of larger boreholes with no increase in power and the production of glass-lined, structurally undisturbed cores which can be recovered with conventional core-retrieval systems. These cores are of significant value in geological exploratory drilling programs. The initial design details and fabrication features of a 114-mm-diam coring penetrator are discussed; significant factors for design optimization are also presented. Results of laboratory testing are reported and compared with performance predictions, and an initial field trial is described.

26265 (ORNL/MIT—219) **Determination and correlation of hydrodynamic variables in a three-phase fluidized bed.** Bloxom, S.R.; Costa, J.M.; Herranz, J.; Roth, S.R.; MacWilliam, G.L. (Massachusetts Inst. of Tech., Oak Ridge, Tenn. (USA). School of Chemical Engineering Practice). 21 Nov 1975. Contract W-7405-eng-26. 74p. Dep. NTIS $4.50.

The basis hydrodynamic variables of minimum fluidization velocity and phase holdups were experimentally measured in a three-phase fluidized bed utilizing a pressure profile technique. The effect of the liquid viscosity on the hydrodynamic variables was determined with glycerine-water solutions ranging in viscosity from 0.9 to 11.5 cp. Computerized techniques for data handling and analysis are presented. Correlations for the phase holdups and minimum fluidization velocities as functions of the phase properties and operating parameters are presented for the experimental data and for data compiled from literature sources. An error analysis was performed on the experimental procedure to identify specific procedures requiring modification or control.

26266 (SAND—76-5428) **Study of the computational and theoretical differences of two finite strain elastic—plastic constitutive models.** Key, S.W.; Biffle, J.H.; Krieg, R.D. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 40p. (CONF-760812—1). Dep. NTIS $4.00.

From US-Germany symposium on finite element analysis; Cambridge, Massachusetts, United States of America (USA) (9 Aug 1976).

What would appear to be two quite different models of material behavior based on the stress fluxes employed are in fact quite similar. The models employed to date in computations, while appearing quite different due to the choice of coordinate systems, are in fact very nearly the same. The next step is to consider time dependent models.

26267 (SVF—21) **Influence of vibrations on heat-exchanger tubes. A literature survey.** Oddving, B.; Wiberg, J. (Stiftelsen foer Vaermeteknisk Forskning, Studsvik (Sweden)). May 1965. 67p. (In Swedish). INIS.

During the last few years vibrations in heat-exchanger tubes have become a more and more serious problem due to increased demands for higher capacities of such components, which, for example, are included in nuclear power plants. These vibrations, which are most frequently induced by vortex shedding in the flow around the tubes, may sometimes cause impact fretting on the tubes and/or baffles where they are in contact with each other. Fretting may occur when two surfaces rub against each other under the influence of a vibrating movement, whereby the amplitudes are rather small (<0.25 mm). Some laboratory experiments have been reported with a combined impact and sliding movement, which is supposed to take place in heat exchangers. The influences of the clearance between the tube and baffle-hole surfaces, pressure normal to the contact surface, amplitude, frequency, time, atmosphere (also water) have been investigated for various material combinations. The finish of the tube and baffle-hole surfaces as well as the shape of the latter may also have an influence on the fretting phenomenon. However, any results from research on this matter have not been found in the literature so far. There are always difficulties in translating the above mentioned laboratory results into real operating conditions. In order to be able to judge whether a given heat exchanger might be subject to vibrational damages or not a few researchers have derived correlations between different flow-, design- and material parameters. That, on the basis of the design and actual operating conditions calculated value of such a correlation, will then indicate the risk of damages due to tube vibrations.

26268 (UCRL—50016-76-1, pp 1-3) **Application of fracture mechanics in high-pressure vessel design.** Prado, M.E. 31 Mar 1976.

In Mechanical Engineering Department quarterly report, January—March 1976.

Fracture mechanics is an analytical tool that can be used in the design of pressure vessels to help guard against brittle failure. It requires consideration of material properties, determination of stress levels and critical crack size, prediction of the vessel's operating life, and establishment of inspection procedures. Research is still needed in many of these areas.

26269 (UCRL—50016-76-1, pp 6-11) **Evaluation of a technique for PIGMA weld quality control.** Freynik, H.S. Jr.; Arluck, J.A. 31 Mar 1976.

In Mechanical Engineering Department quarterly report, January—March 1976.

A line-scanning radiation thermometer was used to detect deliberate weld-head jogs in the first pass of a pressurized-inert-gas-metal-arc (PIGMA) weld. It was concluded that the cost and effort of adapting it to production welding would be greater than the benefits warrant. However, a displacement transducer and a rotary shaft encoder mounted on production welders could provide a time-history of both unintentional and deliberate weld-head motions.

26270 (SAND—76-6023) **Contribution to the study of scale effects on parachute performance data.** Saliaris, C. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Braunschweig (Germany, F.R.). Inst. fuer Flugmechanik). 21 Apr 1975. Translation of Internal report IB—154-75/9. 24p. Dep. NTIS $3.50.

The similarity criteria (parameters) most important for parachute performance data are described, and a short treatment is given of the experimental apparatus and installations used for the study of the relationships between the similarity criteria and parachute performance data. The effects of the Froude number and the mass parameter on the load factor, the dimensionless filling time for the circular flat parachute, and on measurements of these effects are discussed.

26271 **TIG welding produces leak-proof joints for nuclear application.** *Can. Mach. Metalwork.*; **86**: No. 8, 35-36(Aug 1975).

A pulsed welding apparatus using a Hobart Cyber-TIG power source with programmed pulsed current has been developed to produce leak-free welds required for a new hermetically sealed leak-free valve for use in nuclear power plants. Advantages of the technique are precise control over travel speed and filler metal addition allowing the weld to be repeated with precision.

26272 **Dynamic high pressure seal for low temperatures.** Chua, J.O.; Terry, R.E.; Ruoff, A.L. (Cornell Univ., Ithaca, NY). *Rev. Sci. Instrum.*; **46**: No. 12, 1708-1709(Dec 1975).

A dynamic high pressure seal is described which operates successfully for numerous cycles to 7 kbar at liquid nitrogen temperature with helium gas as the pressure medium.

26273 **Heat exchanger.** Wolowodiuk, W. (to Energy Research and Development Administration). US Patent 3,930,537. 6 Jan 1976. Filed date 6 May 1974. 4p.

PAT-APPL-467,168.

A heat exchanger of the straight tube type is described in which different rates of thermal expansion between the straight tubes and the supply pipes furnishing fluid to those tubes do not result in tube failures. The supply pipes each contain a section which is of helical configuration.

26274 **Hermetically sealed motor blower unit with stator inside hollow armature.** Donelian, K.O. (to Energy Research and Development Administration). US Patent 3,933,416. 20 Jan 1976. Filed date 1 May 1945. 10p.

PAT-APPL-591,240.

A description is given of a hermetically sealed motor blower unit comprising, in combination, a sealed housing having a thrust plate and a re-entrant wall forming a central cavity, a rotor comprising an impeller, a hollow shaft, and a thrust collar, journal bearings for supporting the radial load of the shaft, and an electric motor for rotating the rotor. A motor-stator is located within the cavity and is adapted to cooperate through a portion of a re-entrant wall with a motor-rotor mounted within the hollow shaft. The portion of the re-entrant wall located between the motor-stator and the motor-rotor is made relatively thin to reduce electrical losses. A fluid pumped by an impeller lubricates the bearing surfaces.

26275 **Product separator.** Welsh, R.A.; Deurbrouck, A.W. (to Energy Research and Development Administration). US Patent 3,933,249. 20 Jan 1976. Filed date 26 Mar 1973. 8p.

PAT-APPL-344,697.

A description is given of a secondary light sensitive photoelectric product separator for use with a primary product separator that concentrates a material so that it is visually distinguishable from adjacent materials. The concentrate separation is accomplished first by feeding the material onto a vibratory inclined surface with a liquid flow, such as a wet concentrating table. Vibrations generally perpendicular to the stream direction of flow cause the concentrate to separate from its mixture according to its color. When the concentrate and its surrounding stream reach the recovery end of the table, a detecting device notes the line of color demarcation and triggers a signal if it differs from a normal condition. If no difference is noted, nothing moves on the second separator. However, if a difference is detected in the constant monitoring of the color line's location, a product splitter and recovery unit normally positioned near the color line at the recovery end, moves to a new position. In this manner the selected separated concentrate is recovered at a maximum rate regardless of variations in the flow stream or other conditions present.

26276 **Interior ballistics of a two-stage light gas gun using velocity interferometry.** Munson, D.E.; May, R.P. (Sandia Labs., Albuquerque, NM). *AIAA (Am. Inst. Aeronaut. Astronaut.) J.*; **14**: No. 2, 235-242(Feb 1976).

An extensive interior ballistics study of a two-stage light gas gun was performed which resulted in a detailed measurement of the projectile velocity as a continuous function of time. The two-stage gun consisted of a 88.9-mm i.d. pump stage and a 28.6-mm i.d. launch stage. Five main parameters of gun operation, propellant mass, piston mass, pump gas, pump gas pressure, and projectile mass were varied in this study. Projectile velocities were measured using a very precise velocity interferometer for any reflecting surface (VISAR) technique. The measurements showed that the initial acceleration of the projectile is discontinuous due to the shock nature of the applied pressure on the projectile upon rupture of the burst diaphragm. These shock accelerations are understood easily via simple shock-tube theory. 9 figures, 3 tables.

26277 **Method and apparatus for regenerating cold traps within liquid-metal systems.** McKee, J.M. Jr. (to Energy Research and Development Administration). US Patent 3,941,586. 2 Mar 1976. Filed date 29 May 1975. 10p.

PAT-APPL-581,612.

Oxide and hydride impurities of a liquid metal such as sodium are removed from a cold trap by heating to a temperature at which the metal hydroxide is stable in a molten state. The partial pressure of hydrogen within the system is measured to determine if excess hydride or oxide is present. Excess hydride is removed by venting hydrogen gas while excess oxide can be converted to molten hydroxide through the addition of hydrogen. The resulting molten hydroxide is drained from the trap which is then returned to service at cold trap temperatures within the liquid-metal system.

26278 **Device for determining carbon activity through pressure.** Roche, M.F. (to Energy Research and Development Administration). US Patent 3,941,566. 2 Mar 1976. Filed date 10 Jan 1975. 8p.

PAT-APPL-540,182.

A hollow iron capsule of annular shape having an interior layer of $Fe_{x-y}O$ and a near absolute internal vacuum is submersed within a molten metal with the inner chamber of the capsule connected to a pressure sensor. Carbon present in the molten metal diffuses through the capsule wall and reacts with the $Fe_{x-y}O$ layer to generate a CO_2—CO gas mixture within the internal chamber. The total absolute pressure of the gas measured by the pressure sensor is directly proportional to the carbon activity of the molten metal.

26279 Welding by electron bombardment. Corcelle, F.; Courjaud, J. (to Commissariat a l'Energie Atomique). US Patent 3,965,326. 22 Jun 1976. Priority date 26 Nov 1973, France. 10p.

The invention relates to improvements in methods and apparatus for electron beam welding, utilizing an electron gun directing an electron beam into a chamber under partial continuous vacuum maintained by continuous pumping. The partical vacuum chamber terminates in a working chamber, and a valve device separates the partial vacuum chamber from the working chamber, the latter being fixed on a support actuated by a displacement device acting in a direction perpendicular to the electron beam. The gun is associated in known manner with a means for maintaining high vacuum and communicating with the partial vacuum chamber through a narrow orifice provided with a closure device, the partial vacuum chamber being associated with individual continuously-acting pumps. The displacement device comprises a first trolley slidably mounted on a second trolley and moving at right angles to the beam, the second trolley being slidably mounted in turn along a direction at right angles to that of the first trolley, on the frame of the machine.

26280 Analytical relations between elastic—plastic fracture criteria. Merkle, J.G. (Oak Ridge National Lab., TN). *Int. J. Pressure Vessels Piping;* 4: No. 3, 197-206(Jul 1976).

The equation of the normalized crack opening displacement (COD) design curve recently proposed in the UK as a basis for determining allowable crack sizes is derived from the Equivalent Energy approximation for the J Integral. It is also shown that another approximation for the J Integral recently proposed by Begley et al. is mathematically equivalent to the normalized COD approach.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 25719, 25998, 26114, 26147, 26148, 26149, 26874, 26896

26281 Gradient wound trim coil for trimming a primary pickup coil. Hesterman, V.W. (to Develco, Inc.). US Patent 3,965,411. 22 Jun 1976. Filed date 21 Jan 1974. 8p.

One or more primary superconductive magnetic field pickup coils are trimmed by means of one or more auxiliary superconductive trim coils coupled to a magnetic flux sensor for sensing the magnetic flux coupled to the sensor by said primary and auxiliary coil circuits. The trim coils preferably each have their respective magnetic axes oriented orthogonally to each other for independent adjustment. The trim coils are wound in the gradient configuration and an adjustable superconductive magnetic shield is provided surrounding each of the respective trim coils for varying the coupling between the respective trim coil and the magnetic field by varying the position of the magnetic shield relative to a null or symmetric position relative to the trim coil. In a preferred embodiment, there are three mutually orthogonal trim coils. 7 claims, 6 drawing figures.

PROTECTIVE STRUCTURES AND EQUIPMENT

26282 (UCRL—77852) **Air filtration enhancement using electronic techniques.** Nelson, G.O.; Richards, C.P.; Biermann, A.H.; Taylor, R.D.; Miller, H.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jun 1976. Contract W-7405-Eng-48. 10p. (CONF-760822—1). Dep. NTIS $3.50.

From 14. US ERDA air cleaning conference; Sun Valley, Idaho, United States of America (USA) (2 Aug 1976).

Dielectrophoretic filtration experiments were conducted on glass, polyester, dacron, Teflon, wool, acrylic and polypropylene filter media. A polydispersed (sigma g = 2.0, ammd = 0.95 μ m) sodium chloride particle was used as a test aerosol. All materials exhibited significant increases in efficiency with increasing field strengths. Efficiencies of greater than 99 percent could be obtained from glass fiber mats using a 13 kV/cm electric field at 16.3 cm/s face velocity.

26283 Horizontal lateral leak detection surveillance systems (10 Feb 1976) (Engineering Materials). (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). (CAPE—2459).

16 drawings.

Drawings and fabrication notes are given for a system to detect leaks of radioactive wastes. Drawings include the power supply, instrument cabinet, instrumentation interconnections, Geiger—Mueller probe, probe housing assembly, preamplifier, amplifier, discriminator, modified instrument system, and special configuration for dry well logging. (PMA)

SHIPPING CONTAINERS

26284 (SAND—76-5370) **Special tests of plutonium shipping containers.** Bonzon, L.L.; McWhirter, M. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. Contract AT(29-1)-789. 20p. (CONF-760813—8). Dep. NTIS $3.50.

From Symposium on the design, construction and testing of packaging for the safe transport of radioactive materials; Vienna, Austria (23 Aug 1976).

Two test series are described which were intended to demonstrate the air transport-worthiness of typical plutonium shipping containers. Historically, testing of radioactive material shipping containers has been limited to certification testing to the existing, applicable specifications. These special tests, however, were devised to establish failure thresholds and to demonstrate survivability under much more severe environments. In the first test series, three container types were subjected to the sequential impact, penetration, crush, fire, and immersion tests required by the federal government for aircraft flight recorder certification. In only one case was there evidence of slight leakage of the surrogate from a container and only after the entire test sequence was completed. The second test series was designed to determine the failure threshold of three container types when subjected to high-speed impacts suggestive of severe aircraft accidents. The parameters evaluated were container type, impact speed, impact attitude, and target. Test results indicate that the containers are sensitive to all parameters, but particularly so to attitude and speed. However, in only a few impact tests were the containers sufficiently damaged so as to release surrogate material.

26285 (SAND—76-5371) **Special closures for steel drum shipping containers.** Bonzon, L.L.; Otts, J.V. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. Contract AT(29-1)-789. 14p. (CONF-760813—9). Dep. NTIS $3.50.

From Symposium on the design, construction and testing of packaging for the safe transport of radioactive materials; Vienna, Austria (23 Aug 1976).

The objective of this program was to develop special lid closures for typical, steel drum, radioactive material shipping containers. Previous experience and testing had shown that the existing container was adequate to withstand the required environmental tests for certification, but that the lid and closure were just marginally effective. Specifically, the lid closure failed to consistently maintain a tight seal between the container and the lid after drop tests, thus causing the package contents to be vulnerable in the subsequent fire test. Recognizing the deficiency, the United States Energy Research and Development Administration requested the development of new closure(s) which would: (1) be as strong and resistant to a drop as the bottom of the container; (2) have minimal economic impact on the overall container cost; (3) maximize the use of existing container designs; (4) consider crush loads; and (5) result in less dependence on personnel and loading procedures. Several techniques were evaluated and found to be more effective than the standard closure mechanism. Of these, three new closure techniques were designed, fabricated, and proven to be structurally adequate to provide containment when a 454-kg drum was drop tested from 9.14-m onto an unyielding surface. The three designs were: (1) a 152-mm long lid extension or skirt welded to the standard drum lid, (2) a separate inner lid, with 152-mm long skirt and (3) C-clamps used at the container-lid interface. Based upon structural integrity, economic impact, and minimal design change, the lid extension is the recommended special closure.

LASERS

REFER ALSO TO CITATION(S) 25443, 26900

26286 (AD-A—011427) **Chemical laser technology. Final report, 30 May 1974—15 Jun 1975.** (Hughes Aircraft Co., Culver City, Calif. (USA). Laser Div.). Jun 1975. Contract N00014-74-C-0363. 53p. (HAC-P—75-191; HAC-Ref-D—1687). NTIS $4.25.

The objectives of the program described are to further elucidate the gasdynamic and kinetic processes in the laser cavity of a cw HF/DF chemical laser. The plan was to collect new diagnostic data on several chemical laser nozzles for different cavity fuels, including D_2, DBr, and DI, and to use this information to develop an improved macroscopic description of the laser fuel/oxidizer mixing process. The baseline description of the mixing process is a one-dimensional, laminar-diffusion model which was developed earlier. Here it is shown that two-dimensional, laminar diffusion is the square root of 3 times faster than 1-d diffusion. A critical feature in the development of the diagnostic techniques is the use of a pulsed electron beam probe to obtain high-spatial-resolution, number density data. Analysis of the pulsed system is presented along with its advantages over the more conventional cw e-beam probe. Work is continuing on the pulsed e-beam diagnostic. Necessary support data measurements on several nozzle configurations were obtained and are reported along with limited systems analysis which supports the use of halogen fuels in large DF/HF chemical laser systems.

26287 (AD-A—011944) **Laser wavefront profiling techniques for pulsed radiation. Final report, 2 Jun 1972—3 Jan 1975.** Gillespie, R.E.; Wick, R.V.; Saxman, A.C. (Eocom Corp., Irvine, Calif. (USA)). Jun 1975. Contract F29650-72-C-0736. 146p. NTIS $5.75.

The rapidly advancing field of high power laser technology has created the requirement for new advanced diagnostic systems. Many approaches have been used in the past to obtain pulsed laser wavefront profiles, all of which are very time consuming and laborious techniques. A critical review was made of the existing approaches and new technologies, and techniques were analyzed for application to the measurement problem. The resulting system used a Hartmann plate sampling approach, along with transfer optics and a silicon-vidicon camera for accomplishing the laser radiation measurement, high-speed signal conditioning electronics and a high-speed digital computer/plotter system were used for data acquisition, processing and display. With this system, a pulsed laser wavefront can be measured to the required accuracies on a timely basis.

26288 (BDX—613-1419) **Integrating sphere photodetector for measurement of continuous-wave and peak laser power.** Wonnell, L.D. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1976. Contract E(29-1)-613. 24p. Dep. NTIS $3.50.

An integrating sphere photodetector utilizing an integrating sphere and a silicon photodiode sensor was developed for measuring both continuous-wave and peak laser power over a spectral wavelength range from 514 to 1064 nm with an estimated average power range from 100 μW to 50 W and peak power greater than 1 kW. This universal detector simplifies optical coupling, improves the peak-measurement accuracy of pulses having rise-times greater than 10 ns, and increases the accuracy and repeatability of some continuous-wave-measurements applications. Its wide acceptance angle of approximately 30 degrees provides a means of collecting all of the output from such widely diverging sources as laser diodes.

26289 (LA-UR—75-1486) **Lasers based on the O(^{1}S) yields O(^{1}D) transition in atomic oxygen.** Judd, O. (Los Alamos Scientific Lab., N.Mex. (USA)). 1975. Contract W-7405-Eng-36. 16p. Dep. NTIS $3.50.

From Summer school on the physics and technology of high-power gas lasers; Capri, Italy (Sep 1975).

Various concepts for realization of a laser based on the O(^{1}S) yields O(^{1}D) transition in atomic oxygen are discussed. The physics of the formation and destruction of O(^{1}S) is considered. The current progress related to laser mechanisms and parametric measurements is reviewed.

26290 (SAND—76-0081) **Laser-fusion research progress report, January—December 1975.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Jun 1976. Contract AT(29-1)-789. 87p. Dep. NTIS $5.00.

Research on the following programs is reviewed: HF lasers, iodine lasers, noble-gas-halide lasers, laser-development-related studies, and laser-excitation-source development. (MHR)

26291 (SAND—76-5170) **Velocity measurements using laser interferometry with automatic signal processing.** Lederer, R.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. Contract AT(29-1)-789. 18p. (CONF-760502—2). Dep. NTIS $3.50.

From ELECTRO-76; Boston, Massachusetts, United States of America (USA) (11 May 1976).

Velocity interferometry is the technique of determining the velocity history of a specimen by illuminating it with a monochromatic light and optically detecting the small changes in frequency of the incident light caused by the specimen motion and carried in the reflected light. VISAR (Velocity Interferometry System for Any Reflector) was developed to measure the velocity of specimens with diffusely reflecting surfaces. The need for improvement led to the concept of a dual VISAR with an automatic data handling capability. The development of such a system is described here. The VISAR measures the velocity by collecting the data through an optical link and transfers representative electrical signals to the data handling system, where they are interpreted and displayed for analysis.

26292 (SAND—76-5542) **Soft x-ray lasers.** Duguay, M.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. 23p. (CONF-760650—1). Dep. NTIS $5.00.

From Summer workshop on synchrotron radiation facilities; Quebec, Canada (14 Jun 1976).

Some of the work done to achieve x-ray laser action at wavelengths below 1000 A is reviewed. Four major approaches to x-ray lasers where experimental work has been done are discussed. (MHR)

26293 **Method and apparatus for reducing diffraction-induced damage in high power laser amplifier systems.** Campillo, A.J., Newnam, B.E.; Shapiro, S.L.; Terrell, N.J. Jr. (to Energy Research and Development Administration). US Patent 3,935,545. 27 Jan 1976. Filed date 2 Jan 1975. 4p.

PAT-APPL-538,225.

Self-focusing damage caused by diffraction in laser amplifier systems may be minimized by appropriately tailoring the input optical beam profile by passing the beam through an aperture having a uniform high optical transmission within a particular radius r_0 and a transmission which drops gradually to a low value at greater radii. Apertures having the desired transmission characteristics may readily be manufactured by exposing high resolution photographic films and plates to a diffuse, disk-shaped light source and mask arrangement.

26294 **Cylindrical laser resonator.** Casperson, L.W. (to Energy Research and Development Administration). US Patent 3,940,711. 24 Feb 1976. Filed date 21 Mar 1974. 4p.

PAT-APPL-453,603.

The properties of an improved class of lasers is presented. In one configuration of these lasers, the radiation propagates radially within the amplifying medium, resulting in high fields and symmetric illumination at the resonator axis. Thus there is a strong focusing of energy at the axis of the resonator. In a second configuration, the radiation propagates back and forth in a tubular region of space.

26295 **Measurement of optical gain in CO gas excited only by fission fragments.** McArthur, D.A.; Tollefsrud, P.B. (Sandia Labs., Albuquerque, NM). *IEEE J. Quant. Electron.*; **QE-12**: No. 4, 244-253(Apr 1976).

Gain has been measured in high-density (approximately 0.5 amagat) CO gas, which was cooled to 77°K and excited with an intense burst of fission fragments induced by a fast-burst reactor (Sandia SPR II). Peak-gain coefficients less than or equal to 0.5 percent/cm were measured in pure CO over the wavelength range 5.1 to 5.33 μ, for fission-fragment energy depositions approximately 200 J/l. Interpreting the measured gains with an approximate steady-state vibrational distribution implies that approximately 25 to 70 percent of the fission-fragment energy deposited in the CO is appearing as excitation of the vibrational modes of the CO molecule.

26296 **New far-infrared laser lines in $N^{15}H_3$.** Bushnell, A.H.; Gundersen, M. (Texas Tech. Univ., Lubbock, TX). *IEEE J. Quant. Electron.*; **QE-12**: No. 4, 260-261(Apr 1976).

Several isotopes of NH_3 have been studied as laser candidates, including ND_2H, NH_2D, ND_3, and $^{15}NH_3$. Lasing was observed in $^{15}NH_3$ at 15.08 and 15.91 μ. Tentative assignments of transitions to the $2\nu_2$ yields ν_2 vibrational levels have been made. Enhanced energy output was observed in $^{14}NH_3$ with the addition of helium.

26297 **Stimulated emission mechanism and energy characteristics of manganese vapor laser.** Bokhan, P.A.; Burlakov, V.D.; Gerasimov, V.A.; Solomonov, V.I. (Institute of Atmospheric Optics, Siberian Branch, Academy of Sciences of the USSR, Tomsk). *Sov. J. Quant. Electron.* (*Engl. Transl.*); **6**: No. 6, 672-674(Jun 1976).

An investigation was made of the stimulated emission mechanism and energy characteristics of an He-Mn mixture. Inelastic collisions of manganese and helium atoms were found to have a considerable influence on stimulated emission. Mixing of the upper and lower laser levels resulted in the transfer of excitation from these to the neighboring levels, which maintained the stimulated emission in the collisional regime and gave rise to a

strong competition between the stimulated emission lines. This made it possible to concentrate the major part of the output radiation energy (over 70%) in the 534.1 nm line. The total output power was 3.5 W when the repetition frequency was optimal (5 kHz); the efficiency of laser action was 0.17% in a self-heated tube whose diameter was 2 cm and volume was 145 cm^3. (AIP)

26298 Up-conversion investigation of the temporal structure of pulses emitted by a high-pressure CO_2 laser. Lobko, V.V.; Matveets, Y.A.; Nikogosyan, D.N. (Institute of Spectroscopy, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.)*; 6: No. 6, 680-681(Jun 1976).

An investigation was made of the temporal structure of pulses emitted from an electron-beam-controlled high-pressure CO_2 laser. These pulses were converted nonlinearly to the visible range in a proustite crystal. The temporal resolution of the method was 3 nsec and it was limited by the band width of the recording system. It was demonstrated experimentally that mode locking occurred when the gas pressure was 3 atm. The advantages and shortcomings of the investigation method were analyzed. (AIP)

26299 Accumulation of excited iodine atoms in iodine photodissociation laser. Analysis of kinetic equations. Arkhipova, E.V.; Borovich, B.L.; Zapol'skii, A.K. *Sov. J. Quant. Electron. (Engl. Transl.)*; 6: No. 6, 686-690(Jun 1976).

An analysis is made of the kinetic model of an iodine photodissociation laser operating in the regime of accumulation of excited iodine atoms. It is shown that in the majority of cases of practical importance the population inversion is limited by the quenching caused by radicals. The degree of decomposition of the starting material is low and the thickness of the excited layer corresponds to one or two optical thicknesses. The inversion lifetime is governed by the accumulation of molecular iodine. Analytic expressions are obtained for concentrations of various components of the medium. (AIP)

26300 Analysis of the kinetic model of iodine photodissociation laser under free-oscillation conditions. Arkhipova, E.V.; Borovich, B.L.; Zapol'skii, A.K. *Sov. J. Quant. Electron. (Engl. Transl.)*; 6: No. 6, 691-695(Jun 1976).

An analysis is made of the kinetic model of the iodine photodissociation laser operating under free-oscillation conditions. It is shown that the laser parameters are strongly influenced by the reactions of radicals with iodine atoms which depopulate the lower laser level and regenerate the original working substance. Analytic formulas are obtained for the time dependences of the output power and concentrations of various components of the working medium. The potentialities of the iodine laser are considered allowing for pyrolysis. (AIP)

26301 Analysis of the influence of fluctuations of the reference frequency and of the resonator length on the frequency instability of a gas laser and requirements to be satisfied by automatic frequency control systems. Vlasov, A.N.; Teselkin, V.V. *Sov. J. Quant. Electron. (Engl. Transl.)*; 6: No. 6, 704-707(Jun 1976).

An analysis is made of technical fluctuations of the emission frequency of a gas laser with an automatic frequency control (AFC) system. The minimum instability of the emission frequency in a time tau is found as a function of tau and of the spectral densities of fluctuations of the reference frequency and of the optical length of the resonator, photodetector and amplifier noise, and parameters of the forced frequency modulation of the output radiation. The transfer function is found for an optimal linear AFC system ensuring minimum instability. The experimental results are given of a determination of the spectral densities of perturbations and of the relative frequency instability. Practical recommendations are given on the design of optical resonators and AFC systems. (AIP)

26302 Two-component molecular laser pumped optically in the 4.3 μ band. Stepanov, B.I.; Trushin, S.A.; Churakov, V.V. (Institute of Physics, Academy of Sciences of the Belorussian SSR, Minsk). *Sov. J. Quant. Electron. (Engl. Transl.)*; 6: No. 6, 715-718(Jun 1976).

Relationships are obtained for calculating the spatial distribution of the single-trip gain in a two-component molecular laser and amplifier pumped optically in the fundamental band. The threshold characteristics of the laser system are investigated for various pressures and compositions of the gas mixture and for various resonator lengths. (AIP)

26303 Jet dye laser pumped by copper vapor laser. Zemskov, K.I.; Isaev, A.A.; Kazaryan, M.A.; Petrash, G.G.; Adamushko, A.V.; Belokon', M.V.; Rubinov, A.N.; Evtukhovich, P.G. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). *Sov. J. Quant. Electron. (Engl. Transl.)*; 6: No. 6, 727(Jun 1976).

An investigation was made of the energy and time characteristics of a jet dye laser pumped by a copper vapor laser. The average output power of tunable dye laser radiation was 0.2 W, the peak power was 1.8 kW, and the efficiency was ~12%. (AIP)

26304 Model of a YAG:Nd/sup 3+/ laser with a semiconductor converter in the pump system. Alferov, Z.I.; Andreev, V.M.; Garbuzov, D.Z.; Davidyuk, N.Y.; Larionov, V.R.; Pashinin, P.P.; Prokhorov, A.M.; Tuchkevich, V.M. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). *Sov. J. Quant. Electron. (Engl. Transl.)*; 6: No. 6, 734-735(Jun 1976).

The results are given of experiments involving the use of a semiconductor converter in the pump system of a YAG:Nd/sup 3+/ laser. This converter absorbs the radiation of a flashlamp distributed over a wide spectral range (0.44—0.08 μ) and transforms it with an efficiency up to 50% into a narrow spectral band in the region of 0.805 μ, which coincides with one of the absorption bands of YAG:Nd/sup 3+/. It is shown that the use of such a converter reduces the laser threshold by a factor of 1.6—1.7 and increases the differential efficiency of the system by a factor of 2.4. (AIP)

26305 Annular lens soft aperture for high power laser systems. Feldman, B.J.; Gitomer, S.J. (Los Alamos Scientific Lab., NM). *Appl. Opt.*; 15: No. 6, 1379-1380(Jun 1976).

Theoretical studies are reported of a simple annular lens soft aperture (ALSA) constructed of laser glass or quartz that does not damage at the pulse energies encountered in a high power amplifier system. To characterize the effect of this lens on laser beams a series of calculations were done with a laser pulse propagation code. (MHR)

26306 Parasitic suppression in large aperture disk lasers employing liquid edge claddings. Guch, S. Jr. (Univ. of California, Livermore). *Appl. Opt.*; 15: No. 6, 1453-1457(Jun 1976).

A liquid edge cladding system for parasitic suppression in large aperture, high gain disk laser amplifiers has been developed and tested. A near-saturated aqueous solution of ZnI_2 was employed for index-matching. Adequate fluorescence absorption was demonstrated using either dissolved $NiCl_2$ or chrome black oxide coating applied to the disk holder. Application of liquid cladding to a 20-cm aperture disk laser amplifier increased energy storage capability by approximately 20 percent over conventional solder glass claddings.

26307 Focusing properties of an aberrated laser beam. Hunt, J.T.; Renard, P.A.; Nelson, R.G. (Univ. of California, Livermore). *Appl. Opt.*; 15: No. 6, 1458-1464(Jun 1976).

A computation procedure using self-similar propagation modes is used to analyze the effect that nonlinear whole beam phase distortions have on the focusing properties of the beam produced by a high power solid state fusion laser. A comparison between the predicted and measured patterns for a prototype fusion laser is given.

26308 Laser induced damage in optical materials: 7th ASTM symposium. Glass, A.J.; Guenther, A.H. (Univ. of California, Livermore). *Appl. Opt.*; 15: No. 6, 1510-1529(Jun 1976).

The Seventh ERDA-ASTM-ONR-NBS Symposium on Laser Induced Damage in Optical Materials was held at the National Bureau of Standards in Boulder, Colorado, on 29—31 July 1975. These Symposia are held as part of the activities in ASTM Subcommittee II on Lasers and Laser Materials, which is charged with the responsibilities of formulating standards and test procedures for laser materials, components, and devices. Over 150 attendees at the Symposium heard forty-five papers on topics relating fabrication procedures to laser induced damage in optical materials; on metal mirrors; in ir window materials; the multipulse, wavelength, and pulse length dependence of damage thresholds; damage in dielectric films and at exposed surfaces; as well as theoretical discussions on avalanche ionization and multiphoton processes of importance at shorter wavelengths. Of particular importance were the scaling relations developed from several parametric studies relating fundamental properties (refractive index, surface roughness, etc.) to the damage threshold. This year many of the extrinsic influences tending to reduce a materials damage resistance were isolated such that measures of their egregious nature could be quantified. Much still needs to be accomplished to improve processing and fabrication procedures to allow a measurable approach to a materials intrinsic strength to be demonstrated.

26309 ARC operated Q switch for laser. Cohn, D.B.; Draggoo, V.G.; Lacina, W.B.; Brown, L.E.; Stone, M.M. (to Northrop Corp.). US Patent 3,964,003. 15 Jun 1976. Filed date 26 Feb 1975. 4p.

A laser beam is passed between a pair of electrodes, the switching of the beam being accomplished by generating an arc

between the electrodes whereby metal vapor is ablated therefrom. The metal vapor acts to either refract or totally block the beam, in either case cutting off the laser output.

26310 Slit injection device. Alger, T.W.; Schlitt, L.G.; Bradley, L.P. (to Energy Research and Development Administration). US Patent 3,963,994. 15 Jun 1976. Filed date 15 Jan 1975. 4p.

A laser cavity electron beam injection device is described provided with a single elongated slit window for passing a suitably shaped electron beam and means for varying the current density of the injected electron beam.

26311 Tunable laser oscillator. Graves, R.E. (to Hughes Aircraft Co.). US Patent 3,965,440. 22 Jun 1976. Filed date 2 Apr 1975. 6p.

A laser oscillator circuit is disclosed which allows the operating frequency of the laser to be tuned over a wide range of frequencies in response to a wideband control signal. A laser oscillator such as that disclosed is useful in optical communications systems and especially in optical receivers utilizing a phase-locked control loop for tracking out frequency variations due to noise and the Doppler shifts.

26312 Electrooptic-Q-switching system for a laser. Firester, A.H. (to Secretary of the Army). US Patent 3,965,439. 22 Jun 1976. Filed date 3 Dec 1974. 6p.

A Q-switching system within a laser cavity is described in which the system comprises configurations of electrooptic material that have electrodes which are connected to a direct current voltage source through a switching circuit. The voltage is applied to the electrodes by the switching circuit at a rate commensurate but not appreciably faster than the time the lasing medium takes to replenish its stored energy. When the voltage is applied on the electrodes the electrooptic material becomes birefringent and the plane of polarization of the light is rotated 90°, thus causing loss in the system and the laser to store more energy before pulsing. When the switching circuit quickly removes the voltage from the electrodes, the loss is this quickly removed and the laser produces a larger peak power pulse even though the average power remains the same.

26313 Stabilizing electrode for cold cathode gas-ion laser. Thatcher, J.B. (to Holosonics, Inc.). US Patent 3,967,214. 29 Jun 1976. Filed date 29 Jan 1975. 6p.

A cold cathode gas-ion laser is described having a stabilizing electrode positioned adjacent the cathode to increase the discharge field strength adjacent the cathode to increase the life span and reliability of the laser during high performance operating conditions.

26314 Flash lamp pumped dye laser. Dere, D.J.; Wallace, R.W. (to Chromatix, Inc.). US Patent 3,967,212. 29 Jun 1976. Filed date 19 Aug 1974. 10p.

An optical cavity for a flash lamp pumped dye laser including a pumping cavity, a birefringent filter and a plurality of frequency doubling crystals is described. Within the pumping cavity the flash lamp is cooled by forced air convection and operated with a dc simmer current. Simultaneously, the dye carrying conduit within the pumping cavity is cooled with water. The operating life of the dye is increased by using selectable filters to remove the ultraviolet radiation eminating from the flash lamp before it falls on the dye. The construction of the pumping cavity permits changing the flash lamp and the dye conduit without disturbing the optical path of the laser.

26315 Heat absorbing sealing method for laser glass. Asahara, Y.; Izumitani, T. (to Hoya Glass Works, Ltd.). US Patent 3,966,447. 29 Jun 1976. Priority date 20 Aug 1973, Japan. 4p.

A sealing method for a laser glass is described which provides a high bonding strength comprising applying a powder mixture of (1) a low melting glass containing an infrared absorbing component and (2) a low expansion high melting glass containing an infrared absorbing component to a laser glass and welding the powder mixture to the laser glass by heating.

26316 Sealing method for laser glass. Asahara, Y.; Izumitani, T.; Nakagawa, K. (to Hoya Glass Works, Ltd.). US Patent 3,966,448. 29 Jun 1976. Priority date 20 Aug 1973, Japan. 4p.

A scaling method for a laser glass is described which provides a high bonding strength comprising applying a powder mixture of (1) a low melting glass for sealing a glass laser and (2) a glass having a higher melting point and lower expansion coefficient than those of the low melting glass, to a laser glass and welding the powder mixture to the laser glass by heating. 6 claims, 1 drawing figure.

26317 X-ray laser with a single crystal waveguide structure. Yariv, A. (to California Inst. of Tech.). US Patent 3,967,213. 29 Jun 1976. Filed date 5 Mar 1975. 4p.

An x-ray laser comprises a single crystal in the form of a thin film with an oriented set of prominent atomic planes so that when the crystal is pumped, x-ray photons which are emitted from one of the atomic constituents of the crystal, experience internal feedback (Bragg scattering) from the atomic planes thereby eliminating the need for external feedback. In addition, the crystal functions as a thin planar waveguide confining the x-ray waves therein, thereby reducing the necessary pumping power and increasing overall efficiency.

26318 Laser wavelength stabilization. Itzkan, I.; Pike, C.T. (to Jersey Nuclear-Avco Isotopes, Inc.). US Patent 3,967,211. 29 Jun 1976. Filed date 17 Jan 1974. 8p.

A system is described for stabilizing the frequency of a laser employing the variation in position of interference patterns which result from a variation in laser beam frequency in passing through a Fabry Perot etalon filter. The system is particularly useful for maintaining strict frequency control at a particular frequency in the output of a tunable laser such as a dye laser for use in isotope separation.

26319 Long-path monitoring: advanced instrumentation with a tunable diode laser. Hinkley, E.D. (Massachusetts Inst. of Tech., Lexington); Ku, R.T.; Nill, K.W.; Butler, J.F. *Appl. Opt.*; **15**: No. 7, 1653-1655(Jul 1976).

Long-path monitoring of atmospheric carbon monoxide with high sensitivity and speed has recently been demonstrated using a tunable diode laser system. Significant progress in improving the multipollutant capability and operating simplicity of the monitoring technique is described. The instrument may also be used to measure high resolution (Doppler-limited) ir spectra for line strength calibration and identification of potential interferences. Its use for this purpose is illustrated and the monitoring sensitivity estimated for several important pollutants, including NH_3, vinyl chloride, and ozone, based on laser spectroscopic measurements. (MHR)

26320 Single-point diamond-turned copper mirrors: figure evaluation. Sollid, J.E. (Los Alamos Scientific Lab., NM); Sladky, R.E.; Reichelt, W.H.; Singer, S. *Appl. Opt.*; **15**: No. 7, 1656-1658(Jul 1976).

The results of optical figure measurements on some large OFHC copper mirrors made by the ERDA, Y-12 facility at Oak Ridge are presented. The mirrors are intended for use in a nominal 2.5-kJ 1-nsec CO_2 laser being built at the Los Alamos Scientific Laboratory. Three kinds of mirrors were evaluated: spherical mirrors 39.4 cm in diameter with a 340-cm radius of curvature, spherical mirrors of the same diameter but with a specified 1064-cm radius of curvature, and flat elliptical mirrors 65.4 cm x 39.4 cm. The mirrors were fabricated from blanks of 6061 aluminum. Electrolytic copper was plated on the aluminum blank. These copper platings were specified to be a minimum of 12.7 μ m thick, and generally they were much thicker. It is anticipated that the primary damage mode would be reflection of the thermal pulse from the interface between the coating and substrate. This thermal pulse would propagate with, at most, sonic velocity. Therefore, if the working optical coating is thicker than the speed of sound times the pulse length, the mirror will survive for at least one exposure. In practice, such plated surfaces have damage thresholds of about 5J/cm². For a reason not fully understood, bare single-point diamond-turned surfaces seem to have somewhat higher damage thresholds than conventionally polished ones. The final optical surface was cut in the copper plating with a single-point natural diamond tool. It is concluded that mirrors of up to 2-m diameter will soon be possible by these techniques. The mirrors examined in this study had a maximim dimension of 65 cm. The figure errors currently detected are generally related to the clamping of the blank and the material from which it is made. A typical figure for this set of mirrors is about 3 waves (visible) peak-to-valley. Further improvements are rapidly being made.

26321 Calorimeters for pulsed lasers: calibration. Thacher, P.D. (Sandia Labs., Albuquerque, NM). *Appl. Opt.*; **15**: No. 7, 1815-1822(Jul 1976).

A calibration technique was developed and tested in which a calorimeter used for single-shot laser pulse energy measurements was calibrated with reference to a cw power standard using a chopped cw laser beam. A pulsed laser is required only to obtain the relative time response of the calorimeter to a pulse. With precautions as to beam alignment and wavelength, the principal error of the technique is that of the cw standard. Calibration of two thermopiles with cone receivers showed —2.5 percent and —3.5 percent agreement with previous calibrations made by the National Bureau of Standards.

26322 Regenerative laser device. Welch, A.B. (to Vought Corp.). US Patent 3,968,456. 6 Jul 1976. Filed date 24 Nov 1967. 6p.

A regenerative laser device is described having remotely located optical components. A resonant cavity having a plurality of transverse modes is defined at one end by a highly reflective retrodirective member and at the other end by a retrodirective member formed of a converging lens and a highly transmissive mirror. A body of laser material is located within the resonant cavity, and there are provided means for exciting the material to create a loop gain of the device that is substantially equal to unity. A collimating lens receives light transmitted through the mirror. An energy source supplies additional energy into the resonant cavity through the collimating lens and mirror to increase the radiation, in at least one of the transverse modes, in the resonant cavity.

26323 Injection laser with integral modulator. Yoder, M.N. (to Secretary of the Navy). US Patent 3,968,455. 6 Jul 1976. Filed date 5 Mar 1974. 6p.

The semiconductor target of a GEISHA or EBIC device was integrated with an injection laser diode to form a unitary structure. The electrons created in the GEISHA by impact ionization are swept directly into the injection laser to cause lasing action. This eliminates the need for transmission line connecting the GEISHA to the injection laser diode.

26324 Beam collimation using multiple coupled elements. Scifres, D.R.; Burnham, R.D.; Streifer, W. (to Xerox Corp.). US Patent 3,969,686. 13 Jul 1976. Filed date 26 Mar 1975. 8p.

An electrically pumped, distributed feedback laser is described having all side surfaces of the active laser medium cleaved and a periodic structure at a 45° angle to all of the cleaved surfaces. Current confining channels restrict pumping current to selected regions of the active laser medium to provide sufficient feedback such that two parallel filamentary areas of the active medium lase. By having multiple lasing filaments the divergence of the output beam in the direction of the width of the filaments is reduced by a factor proportional to the number of filamentary lasing areas.

26325 Standing wave unstable resonators for radial flow lasers. Freiberg, R.J.; McLafferty, G.H. (to United Technologies Corp.). US Patent 3,969,687. 13 Jul 1976. Filed date 14 Apr 1975. 8p.

A radial flow laser having an unstable resonator configuration with a standing wave optical path is disclosed. The gain medium forms a cylindrical sheath which is symmetric about a centerline axis through the resonator and the output beam is annular in cross section. The resonator geometry is based on a circular end mirror, an annular end mirror, an annular folding mirror having a reflective surface conforming to the inside of a cone geometry and conical folding mirror conforming to the outside of a cone geometry. Various embodiments are disclosed whereby the width of the resonant mode is either held constant or expanded to accommodate various power density loadings on the mirrors. In one configuration, the standing wave travels in a complete loop through the cylindrical sheath of gain medium.

26326 Traveling wave unstable resonators for radial flow lasers. Freiberg, R.J.; McLafferty, G.H. (to United Technologies Corp.). US Patent 3,969,688. 13 Jul 1976. Filed date 14 Apr 1975. 6p.

A radial flow ring laser having an unstable resonator configuration with a traveling wave optical path is described. The gain medium forms a cylindrical sheath which is symmetric about a centerline axis through the resonator and the output beam is circular in cross section. The resonator geometry is based on first and second conical mirrors which are positioned symmetrically on the axis centerline and first and second annular mirrors which are symmetric about the axis and complete the ring path. The resonator description also includes an annular stripper mirror to produce the output beam of radiation and a suppression mirror to prevent a traveling wave in the undesired direction through the ring. An alternate embodiment includes a cylindrical folding mirror to cause the optical path to cross the centerline axis after each pass through the gain medium.

26327 Method for reducing the width of a laser pulse and a corresponding double-resonator laser. de Witte, O.; Eranian, A.; Dezauzier, P. (to Agence Nationale de Valorisation de la Recherche). US Patent 3,969,684. 13 Jul 1976. Priority date 12 Jan 1973, France. 16p.

The laser comprises an amplifying medium which sustains the oscillation within two resonators, one resonator being formed by the mirrors M_1 and M'_1 and the other being formed by the mirrors M_2 and M'_2. The quality factor of the second resonator is higher than that of the first resonator. The time-duration of the pulse extracted from the first resonator is adjusted by modifying the quality factor of the second resonator. The double-resonator laser serves to generate pulses of very small width, especially in dye lasers, and to adjust pulse-widths in such applications as telemetry.

26328 Enhanced radiation coupling from unstable laser resonators. Chenausky, P.P.; Freiberg, R.J. (to United Technologies Corp.). US Patent 3,969,685. 13 Jul 1976. Filed date 6 Dec 1974. 10p.

A method and apparatus for providing a large fraction of the energy coupling from an unstable resonator in the central lobe of the far field pattern of the output beam from the resonator are described. The resonator is designed to allow a low order mode pattern to resonate about the optical axis therethrough and radiation is coupled out from both the axial region and the outer region of the mode. The geometry of the systems is formed with transmissive and reflective optics in various configurations of linear and ring lasers.

26329 Gas dynamic-transfer chemical laser. Lee, L.A. US Patent 3,970,955. 20 Jul 1976. Filed date 6 Dec 1974. 4p.

A gas dynamic-transfer chemical laser is formed by burning a halogenated and deuterated tetrazole and expanding the combustion products through a supersonic nozzle and injecting into the expanding products, a secondary stream of cold D_2 or cold H_2.

26330 Flowing gas laser gas regeneration system. Regan, A.J. (to BOC Ltd.). US Patent 3,970,957. 20 Jul 1976. Priority date 23 Oct 1973, United Kingdom of Great Britain and Northern Ireland (UK). 4p.

A gas laser is described that includes a discharge tube containing a gas mixture, the discharge tube having one or more inlets and an outlet, in which a reaction vessel is in communication with said outlet and with the inlet of a vacuum pump, and in which the outlet of the vacuum pump is in communication with the outlet or each inlet of the discharge tube.

26331 Thermionic cathode transverse-discharge gas laser tube. Breaux, O.P.; Medicus, G.K. (to Secretary of the Air Force). US Patent 3,970,961. 20 Jul 1976. Filed date 9 May 1975. 6p.

An improved transverse-discharge gas laser tube is provided by positioning thermionic cathodes diametrically opposite each other across the plasma location with anodes positioned at 90° to the cathodes all contained within an electron repelling envelope. Laser configurations for both large and small circular cross-section plasmas are disclosed. A thermionic cathode plasma slab laser with a magnetic field that may be modulated to provide modulation of the laser beam is also disclosed.

26332 High power electrically excited flowing gas laser. Peressini, E.R.; Hill, R.A.; Kallis, J.M. (to Hughes Aircraft Co.). US Patent 3,970,962. 20 Jul 1976. Filed date 7 Nov 1974. 12p.

A high power, cw, high pressure, electrically excited flowing gas laser is disclosed wherein a laser excitation transverse to the direction of gas flow is initiated by a uniform electron beam perpendicular to the gas flow direction. Laser gas supplied to a plenum chamber at a pressure substantially greater than atmospheric pressure is conditioned by a perforated plate nozzle to flow through the laser cavity in a uniform stream at the desired subsonic velocity. A variable angle diffuser is provided downstream from the laser cavity to decelerate and compress the laser gas before exhausting it into the ambient atmosphere such that at the downstream end of the laser excitation region the laser gas is maintained at a pressure slightly lower than atmospheric pressure.

26333 High-power argon/nitrogen transfer laser. Olson, N.T.; Ault, E.R.; Bhaumik, M.L. (to Northrop Corp.). US Patent 3,970,964. 20 Jul 1976. Filed date 5 Sep 1974. 10p.

A new class of high-power lasers capable of high efficiencies in the visible and shorter wave lengths is described, employing an excitation energy transfer mechanism from a pumped noble donor gas, such as argon, to an acceptor lasing gas, preferably nitrogen. In particular, such as argon/nitrogen laser exhibits a very useful, unique output wave length at 3577A, this being derived from a mixture of argon, predominantly, with a minor percentage of nitrogen, excited by a relativistic electron beam of relatively high current density. Such gas lasers with a noble gas as donor offer great promise, using high electrical conversion efficiency of the noble donor gas with a non-radiative energy transfer to the lasing gas.

26334 Electrically pumped, solid-state distributed feedback laser with particular grating spacing. Streifer, W.; Scifres, D.R.; Burnham, R.D. (to Xerox Corp.). US Patent 3,970,958. 20 Jul 1976. Filed date 15 Oct 1974. 8p.

A distributed feedback, (DFB) electrically pumped diode laser is described in which the spacing of the periodic structure within the diode is selected to optimize the interaction between the periodic structure and the electromagnetic waves in the diode laser. The degree to which the waves interact with the periodic structure is described mathematically by a coupling constant K, with larger values of K corresponding to lower gains required to

produce laser operation. It is shown that in DFB diode lasers higher order transverse modes have a higher coupling constant K with the periodic structure than does the lowest order transverse mode and thus the higher order transverse modes will lase more easily than the lowest order transverse mode.

26335 Two dimensional distributed feedback devices and lasers. Wang, S.; Sheem, S.K. (to Univ. of California). US Patent 3,970,959. 20 Jul 1976. Filed date 4 Dec 1974. 22p.

Optical devices and waveguides using a thin film optical waveguide that have a two dimensional array of perturbations associated therewith or with adjacent optically coupled layers are described. The array is regular and forms periodic variations in two non-coincident directions which serve to reflect or scatter light waves into controllable transverse modes of propagation. Lasers as well as passive devices are discussed.

26336 Waveguide laser arrangement for generating and combining a plurality of laser beams. Chester, A.N. (to Hughes Aircraft Co.). US Patent 3,970,963. 20 Jul 1976. Filed date 1 May 1975. 6p.

Laser arrangements are disclosed wherein a plurality of individual laser beams at slightly different wavelengths are generated in respective capillary bore waveguides in a common body of dielectric material. The generated laser beams are caused to converge upon a preselected intersection point, either by constructing the bore waveguides with converging longitudinal axes or by deflecting the generated laser beams into the desired converging paths by means of an optical prism. A diffraction grating is positioned at the laser beam intersection point to combine the respective laser beams emitted from the bore waveguides into a composite beam along a coincident path.

26337 Broadly tunable continuous-wave laser using color centers. Mollenauer, L.F. (to Bell Telephone Labs., Inc.). US Patent 3,970,960. 20 Jul 1976. Filed date 3 Mar 1975. 24p.

Broadly tunable infrared lasers analogous to dye lasers operating in the visible spectrum are provided by significant improvements upon an F/sub A/(II) color center laser previously demonstrated in a limited way. The improvements include techniques for also using F/sub B/(II) and F_2 *color centers and include substantially increased concentrations of the F-centers in regions of pumpable geometry, judicious choice of pumping frequencies and powers and variable, frequency-selecting resonators that are capable of producing oscillation anywhere in the color center fluorescence bands. All solid-state cooling by means of contact between the crystal and a solid heat sink is provided in a way that provides the optical quality needed for efficient operation and for greatest tuning bandwidth of the laser. Use of the color centers in distributed feedback devices is described.

26338 Control of HF laser output spectrum using selective intracavity loss. Fisk, G.A.; Hays, G.N. (Sandia Laboratories, Albuquerque, New Mexico 87115). *J. Appl. Phys.*; **47**: No. 9, 4044-4047(Sep 1976).

It is shown experimentally that the addition of gas-phase absorbers into the cavity of a small pulsed HF laser reduces the number of lasing lines, without seriously reducing output energy, for 200-ns FWHM laser pulses. This effect is discussed in terms of the rapid rotational relaxation characteristic of gas-phase HF and the fact that the losses introduced are frequency selective. (AIP)

26339 14- and 16-μ gasdynamic CO_2 lasers. Manuccia, T.J.; Stregack, J.A.; Harris, N.W.; Wexler, B.L. (Laser Physics Branch, Optical Sciences Division, Naval Research Laboratory, Washington, D. C. 20375). *Appl. Phys. Lett.*; **29**: No. 6, 360-362(15 Sep 1976).

Laser action at 16 μ has been obtained between the (02degree0) and (01^10) levels as well as between the (10degree0) and (01^10) levels at 14 μ. A 9- or 10-μ saturating pulse equilibrates the (001) level with either the (02degree0) or (10degree0) level and creates the transient 14- or 16-μ inversion. Extraction efficiencies of 20% have been achieved on a single pulse. Repetition frequencies of 200 Hz have been achieved using a single Q-switched cavity. (AIP)

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 25745, 25796, 25884, 26273

26340 (CONF-760810—1) **Experimental study of flow monitoring instruments in air-water, two-phase downflow.** Sheppard, J.D.; Hayes P.H.; Wynn, M.C. (Oak Ridge National Lab., Tenn. (USA)). 1976. 24p. Dep. NTIS $3.50.

From Specialists meeting on transient two-phase flow; Toronto, Canada (3 Aug 1976).

The performance of a turbine meter, target flow meter (drag disk), and a gamma densitometer was studied in air-water, two-phase vertical downflow. Air and water were metered into an 0.0889-m-ID (3.5-in.) piping system; air flows ranged from 0.007 to 0.3 m^3/sec (16 to 500 scfm) and water flows ranged from 0.0006 to 0.03 m^3/sec (10 to 500 gpm). The study included effects of flow rate, quality, flow regime, and flow dispersion on the mean and fluctuating components of the instrument signals. Wire screen flow dispersers located at the inlet to the test section had a significant effect on the readings of the drag disk and gamma densitometer, but had little effect on the turbine. Further, when flow dispersers were used, mass flow rates determined from the three instrument readings and a two-velocity, slip flow model showed good agreement with actual mass flow rate over a three-fold range in quality; mass flows determined with the drag disk and densitometer readings assuming homogeneous flow were nearly as accurate. However, when mass flows were calculated using the turbine and densitometer or turbine and drag disk readings assuming homogeneous flow, results were scattered and relatively inaccurate compared to the actual mass flows. Turbine meter data were used with a two-velocity turbine model and continuity relationships for each phase to determine the void fraction and mean phase velocities in the test section. The void fraction was compared with single beam gamma densitometer results and fluid momentum calculated from a two-velocity model was compared with drag disk readings.

26341 Bulk gas temperature measurement during vessel discharge using transient PVT. Johnston, S.C. (Sandia Labs., Livermore, CA); Dwyer, H.A. *Rev. Sci. Instrum.*; **46**: No. 12, 1697-1698(Dec 1975).

A transient pressure—volume—temperature (PVT) experimental technique for determining true bulk gas temperature during gas discharge from a vessel to the atmosphere is described. The bulk temperature obtained is valid no matter how nonuniform gas temperature is inside the vessel and accounts for all modes of heat transfer during discharge.

26342 Rheological properties of suspensions of rigid particles. Jeffrey, D.J.; Acrivos, A. (Stanford Univ., CA). *AIChE (Am. Inst. Chem. Eng.) J.*; **22**: No. 3, 417-432(May 1976).

Experimental and theoretical work on the rheological properties of suspensions are reviewed. Attention is focused on systems consisting of rigid, neutrally buoyant particles suspended in Newtonian fluids; no restrictions, however, are placed on the concentration of the particles or on the forces acting in the suspension. The assumption that an effective viscosity depending solely on the volume fraction of the particles suffices to describe the rheology of suspensions is examined and shown to be inadequate. Indeed, the experimental evidence strongly supports the view that suspensions behave macroscopically as non-Newtonian fluids whose rheological properties are influenced by a large number of factors; these factors are listed. The various theories that have been put forward to explain the flow of suspensions are discussed, with particular emphasis placed on the nature of the approximations made, so that purely empirical formulas can be clearly separated from those having a theoretical basis. Suggestions for future work, both theoretical and experimental, are provided.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 25740, 25770, 26045, 26066, 26067, 26278, 26378

26343 (COO—2733-5) **Mechanical behavior of materials and structural elements at elevated temperatures. Progress report, June 1, 1975—May 31, 1976.** Lance, R.H.; Mukherjee, S. (Cornell Univ., Ithaca, N.Y. (USA)). May 1976. Contract E(11-1)-2733. 21p. Dep. NTIS $3.50.

Research performed between June 1, 1975 and May 31, 1976 on the mechanical behavior of materials and structural elements at elevated temperatures is summarized. The analytical portion of the research performed includes solutions of several boundary value problems for structural components subjected to steady loads with and without steady thermal gradients using Hart's constitutive relations for the material. Study of crack propagation in a ductile material has been initiated. The experimental portion of the research, designed to perform creep experiments on structural components at room and elevated temperatures, has been started. Hardware is being built and measuring equipment is being purchased.

26344 (EURISOTOP—85) **Industrial radiography. Gamma radiography.** Menetrier, J. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). 1975. 66p. (In French, German, Italian, Dutch). INIS.

Information is given on gamma radiodefectology regulations, entire references, and main dispositions applicable to each state of the European Economic Community. The contents include previous arrangements for source acquisition, holding and use of the sources, transport, accidents, civil liability of the source holder, personnel insurance against radiation hazards and contamination, property insurance, and penal liability of the source holder.

26345 (JAERI-M—5829, pp 121-127) **On neutron radiography.** Tomii, K. Sep 1974. (In Japanese).

From 1. conference on applications of neutron scattering; Tokai, Ibaraki, Japan (11 Jan 1974).

In Proceedings of the first conference on applications of neutron scattering.

Neutron radiography can be used for materials inspection which is difficult by x- or γ-ray radiography, such as the identification of isotopes or the substances having close atomic number, and can be used to obtain the image of strongly radioactive bodies. There is room for improvements in photographing techniques and in the quality and quantity of neutron beams. Beam collimation is required to some extent, and thermal or epi-thermal neutrons of 10^5n/cm²ec to 10 ℏ/cm ³ec are suitable neutron fluxes. There are two methods, transcription and direct photographing, of photographing techniques. Scintillator converters are sensitive and can have good resolution depending on production method, but further development is required. At present, the application of neutron radiography is limited mainly to bodies incapable of x-ray images, such as reactor fuels and materials.

26346 Apparatus for examining a body by means of penetrating radiation. Hounsfield, G.N. (to EMI Patents Ltd.). US Patent 3,965,357. 22 Jun 1976. Filed date 1 Mar 1974. 8p.

The invention relates to apparatus for examining a body by means of penetrating radiation in which a source of radiation produces a beam of radiation which passes through the body, and a detector receives the radiation emerging from the body. The source and the detector are mounted on a scanning structure which can undergo successive lateral scans at a succession of orbital positions so that a plane section of the body is traversed by a set of parallel beams at each of the body is traversed by a set of parallel beams at each of the orbital positions. A reference attenuator provides a known attenuation of the beam at the beginning of each lateral scan, and means are provided for modifying the output signals during each lateral scan in response to the signal obtained when the beam is passing through the reference attenuator. In this way compensation is effected for rapid changes in the sensitivity of the detector.

26347 Positron probes for mechanical fatigue detection system. Holt, W.H.; Mock, W. Jr. (to Secretary of the Navy). US Patent 3,970,855. 20 Jul 1976. Filed date 23 May 1975. 6p.

The invention comprises positron-emitting probes for use in testing samples of metals for fatique by positron annihilation techniques comprising a substrate made from the same material as the test sample, positron-emitting material supported by one surface of the substrate, and a cover for the emitting material, the cover is sealed to the substrate and is of such thinness and density as to provide a window through which positron passage is unimpeded.

SAFETY ENGINEERING

26348 (UCRL—77724(Rev.1)) **High-pressure safety at the Lawrence Livermore Laboratory, an energy research facility.** Burton, W.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 May 1976. Contract W-705-eng-48. 23p. (CONF-760905—8). Dep. NTIS $3.50.

From International joint pressure vessels and piping and petroleum mechanical engineering conference; Mexico City, Mexico (19 Sep 1976).

The high-pressure safety program at Lawrence Livermore Laboratory, Livermore, California, has been successful in preventing lost-time high-pressure accidents over the past 12 years. Program organization, personnel training and qualification, pressure vessel design criteria and documentation, and pressure testing and inspection are discussed.

26349 Electronic Klaxon alarm (3 Dec 1975) (Engineering Materials). (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE—2490).

3 drawings.

A drawing is given for a klaxon alarm printed circuit (PC) board, designed to plug into a Federal 300 Series Selectone Signalling Device. With modifications, it could be used with other signalling devices. Waveforms are generated on the PC board that closely simulate those found on a recording of a mechanical klaxon. Two sine wave oscillators, not synchronized together, generate frequencies of approximately 800 Hz and 2.2 KHz. These are gated into a summing amplifier once every cycle of the lower frequency oscillator.

26350 Pumpable rockbolt method. Steinberg, M.; Manowitz, B.; Waide, C.H. (to Energy Research and Development Administration). US Patent 3,930,639. 6 Jan 1976. Filed date 27 Sep 1974. 8p.

PAT-APPL-509,998.

A method and apparatus are described for producing rockbolts in the roof of a subterranean cavity in which two components of an ambient temperature curable resin system are premixed and then inserted into a bore hole. The mixture is permitted to polymerize in situ, and then the hardened material is cut off at the entrance to the hole leaving a hardened portion for insertion into the next hole as a precursor. In a preferred embodiment, a flexible glass roving is employed to reinforce the material in the hole and a metal tube inserted to support the roving while it is fed into the hole and also to provide venting. The roving and tube is then cut off and left in the hole.

26351 Protective air lock. Evans, H.W. (to Energy Research and Development Administration). US Patent 3,946,645. 30 Mar 1976. Filed date 14 Dec 1949. 8p.

PAT-APPL-132,921.

A device suitable for preventing escape and subsequent circulation of toxic gases is described. An enclosure is sealed by a surrounding air lock, and an automatic mechanism partially evacuates the enclosure and air lock. The enclosure ventilating mechanism can be disconnected so that a relatively undisturbed atmosphere is created in the enclosure.

VACUUM ENGINEERING

26352 (BNL—21616) **Upper bound to the pressure in an elementary vacuum system.** Edwards, D. Jr. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. Contract E(30-1)-16. 49p. (CONF-760921—1). Dep. NTIS $4.00.

From 23. National vacuum symposium; Chicago, Illinois, United States of America (USA) (21 Sep 1976).

A vacuum system consisting of a volume V, a pump S and a surface area A on which there are initially adsorbed n(0) molecules in a first order desorption state is considered and discussed. The essential result is that P/sub max/ = 1.146 x 10^{-5} A/St torr is expected to provide a reasonably accurate estimate for the value the pressure should be strictly less than t seconds after the pumping has started given that the pressure in the system is due to an adsorbed surface phase. Experimental tests of this relation have been performed and comparisons are made between this result and the pressure measured in an elementary vacuum system.

26353 Apparatus for detecting leaks. Booth, E.T. (to Energy Research and Development Administration). US Patent 3,939,695. 24 Feb 1976. Filed date 26 Feb 1974. 6p.

PAT-APPL-12,455.

A method and apparatus are described for determining the position of and estimating the size of leaks in an evacuating apparatus. A testing gas, such as helium or hydrogen, flows around the apparatus and is drawn in at the site of any leaks.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 26349

26354 (SAND—76-5286) **Gold aluminum interconnect stability on thin film hybrid microcircuit substrates.** Bushmire, D.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). Apr 1976. 8p. (CONF-760457—1). Dep. NTIS $3.50.

From International realiability physics symposium; Las Vegas, Nevada, United States of America (USA) (20 Apr 1976).

The effects of gold aluminum intermetallic growth on the stability of interconnects to thin film hybrid microcircuits were studied. Three different metallization systems were evaluated using three types of bonding wire. Tantalum-nitride-chromium-gold was bonded using 0.031 mm aluminum 1 percent Si wire and 0.031 mm aluminum 1 percent Mg wire. These two wire types were also bonded to substrates metallized with tantalum-nitride titanium-palladium-gold. Also, gold wire (0.025 mm) was bonded to aluminum metallization. These metallization-bond systems were evaluated by subjecting the tests specimens to various known temperatures and time environments followed by loop pull tests to destruction, bond

shear tests to destruction, and four-point probe electrical resistance measurements. The environments included 1000 h of storage at 100, 200, and 300°C and temperature cycling from -40 to 200°C for 10, 50, 100, 500, 1000 cycles. The data shows that the electrical resistance increases drastically long before mechanical integrity is degraded. It was not uncommon to see kilohms. The results of aging gold wire bonding to aluminum metallized substrates are described. Stabilized and unstabilized wire were used, and the effects of time and temperature on bond integrity are reported. Both were types degraded mechanically and electrically with little differences between the two.

26355 Method and means for measuring acoustic emissions. Renken, C.J. Jr. (to Energy Research and Development Administration). US Patent 3,930,405. 6 Jan 1976. Filed date 17 Sep 1974. 4p.

PAT-APPL-506,819.

The detection of acoustic emissions emanating from an object is achieved with a capacitive transducer coupled to the object. The capacitive transducer is charged and then allowed to discharge with the rate of discharge being monitored. Oscillations in the rate of discharge about the normally exponential discharge curve for the capacitive transducer indicate the presence of acoustic emissions.

26356 High current capacity electrical connector. Bettis, E.S.; Watts, H.L. (to Energy Research and Development Administration). US Patent 3,932,014. 13 Jan 1976. Filed date 20 Mar 1975. 4p.

PAT-APPL-560,428.

An electrical connector is provided for coupling high current capacity electrical conductors such as copper busses or the like. The connector is arranged in a "sandwiched" configuration in which a conductor plate contacts the busses along major surfaces clamped between two stainless steel backing plates. The conductor plate is provided with contact buttons in a spaced array such that the caps of the buttons extend above the conductor plate surface to contact the busses. When clamping bolts provided through openings in the sandwiched arrangement are tightened, Belleville springs provided under the rim of each button cap are compressed and resiliently force the caps into contact with the busses' contacting surfaces to maintain a predetermined electrical contact area provided by the button cap tops. The contact area does not change with changing thermal or mechanical stresses applied to the coupled conductors.

26357 Computer interactive resistance simulator (CIRS). Mayn, B.G. (to Energy Research and Development Administration). US Patent 3,947,675. 30 Mar 1976. Filed date 3 Jan 1975. 6p.

PAT-APPL-538,490.

A system is described for simulating the insertion of electric resistance values of either positive or negative quantity into an electric circuit. The device is used for cancelling drift errors.

SOLID WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 25539

26358 Union Electric Company's 8000 ton per day solid waste utilization system. Klumb, D.L. pp 77-88 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

Full-scale testing to determine the feasibility of burning suitably prepared solid waste in an existing coal-fired utility boiler has been underway in St. Louis since April 1972. As a result of the experience, the Union Electric Company of St. Louis has implemented plans to build, own, and operate an 8,000 ton/day Solid Waste Utilization System capable of utilizing essentially all the solid waste generated in the metropolitan area. The system is described with a discussion of the following aspects: collection and transport, processing facilities, solid waste characterization, environmental impact, and economics. The system is being built as a free enterprise, profit-making venture with no Federal funds involved. (JSR)

26359 Chicago's refuse disposal system: organization and financing. Suloway, M. (Dept. of Public Works, Chicago). pp 437-446 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The city of Chicago is constructing a waste-processing plant for materials recovery and for processing of the solid refuse for use as a supplementary fuel in a coal-fired power plant. The factors leading to the decision to build this installation are summarized. (JSR)

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 25296

26360 Furnace exhaust system. Mach, V.F. (to General Resource Corp.). US Patent 3,963,416. 15 Jun 1976. Filed date 19 Jun 1975. 8p.

Apparatus is disclosed for attachment adjacent to an open end of a rotary furnace, having a first effluent furnace gas exhaust duct projecting into the furnace and a dust collecting hood adjacent to the furnace opening. A pressurized air duct plenum having a plurality of air jet holes directs a curtain of air across the furnace open end, and a receiving air duct plenum having a plurality of openings collects the air curtain for exhausting via a filter system. The hot effluent furnace gas is passed through a gas-to-gas heat exchanger and to the aforementioned filter system.

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

26361 (ANL-HEP-CP—76-18) **Future utilization of polarized beams and targets at the ZGS. Report of the Technical Advisory Panel.** (Argonne National Lab., Ill. (USA)). Apr 1976. 34p. Dep. NTIS $4.00.

A program is proposed for upgrading the usefulness and attractiveness of ZGS polarized facilities to the user community. It is hoped that the advance approval or completion of parts (or all) of such a program will lead to an accelerated interest in proposing experiments unique to the ZGS, which will open new dimensions in the understanding of high energy phenomena. Recommendations are summarized, and a discussion is given of past activities and future plans of various experimental groups and ZGS facilities. A series of arguments is made concerning possible future ZGS facilities which do not necessarily relate to any specific experiments, suggested or proposed.

26362 (LBL—4696) **Rock excavation by pulsed electron beams.** Avery, R.T.; Keefe, D.; Brekke, T.L.; Finnie, I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1976. Contract W-7405-ENG-48. 6p. Dep. NTIS $3.50.

If an intense short pulse of megavolt electrons is deposited in a brittle solid, dynamic spalling can be made to occur with removal of material. Experiments were made on several types of hard rock; results are reproducible and well-described theoretically. An accelerator with a rapidly-pulsed scanning electron beam was designed that could tunnel in hard rock about ten times faster than conventional drill/blast methods.

26363 (TM—609) **Production of radioactivity by particle accelerators.** Gollon, P.J. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). 7 May 1976. 5p. (CONF-7509115—1). Dep. NTIS $3.50.

From Lecture at the international school of radiation damage and protection; Erice, Italy (Sep 1975).

At all accelerators with energies greater than some tens of MeV, induced radioactivity results whenever beams interact with accelerator or beam transport components. Typically these interactions occur at injection and extraction points and beam splitting stations. Losses at these points are not desirable, and great efforts are often required to reduce them. Beam losses also occur at collimators, scrapers, target areas and beam dumps; these losses are deliberate and cannot be reduced. Consequently, these are usually the most radioactive areas of the accelerator, and work near them is the largest source of radiation exposure at all laboratories. It is therefore necessary to be able to anticipate the magnitude of the problems involved in such work, in order to minimize those problems in the design of a new facility. While these loss points are common to all accelerators, the magnitude of the resulting problems depends on many factors unique to each accelerator: the type of particle accelerated, the particle energy, and the geometry

and composition of the items being struck. These considerations are discussed, and a general introduction for those not actively involved in this area is presented.

26364 (UCID—17146) **RTNS-II technical development plan.** Davis, J.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1976. Contract W-7405-Eng-48. 113p. Dep. NTIS $5.50.

The goal of the RTNS-II (Rotating Target Neutron Source) project at the Lawrence Livermore Laboratory is to provide a dedicated facility for investigation of 14-MeV neutron damage processes in materials to be used in controlled thermonuclear fusion reactors. LLL will operate the RTNS-II facility for ERDA as a national materials damage center. This Technical Development Plan describes the need for 14-MeV neutron sources, the physics and engineering design basis for the beam-target sources to be built for the RTNS-II facility, and the research support equipment included in the facility. Fiscal and manpower schedules for construction and operation of the facility are included. Finally, the accelerator and target research program directed at raising the strength of these sources from the design goal of 4 x 10^{13} n/s to higher levels is described.

AUXILIARIES AND COMPONENTS

26365 (LA-tr—76-1) **Study of the conditions of compensation of perturbations in an accelerating structure with drift tubes.** Bomko, V.A.; Rudiak, B.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1976. Translation by H.J. Dahlby from pp 11-14 of KHFTI—75-12. 13p. Dep. NTIS $3.50.

A method is discussed for stabilizing the distribution of the accelerating field in a linear accelerator with drift tubes. The principle of degeneration of interfering modes is used with a stabilization system of the "antipode" type. Results are given for experimental studies on suppressing the intensity of fields of interfering waves and on the effect of dividing the frequencies as a function of the resonator length and the number of resonator posts. (PMA)

26366 (LA-tr—76-2) **Method of shaping fields of controlled extension in a resonator with a large electrical length.** Bomko, V.A.; Rudiak, B.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1976. Translation by H.J. Dahlby from pp 8-10 of KHFTI—75-12. 10p. Dep. NTIS $3.50.

A method is discussed for controlling the energy of particles accelerated in a linear accelerator consisting of a volume resonator with drift tubes. Results are described for experimental studies of problems with field shaping of controlled extension of fields in an accelerating structure having drift tubes and a large electrical length. The possibility of shaping the field in a resonator using a stabilizing system of the "antipode" type is considered. (PMA)

26367 **Accelerator beam profile analyzer.** Godel, J.B.; Guillaume, M.; Lambrecht, R.M.; Withnell, R. (to Energy Research and Development Administration). US Patent 3,937,966. 10 Feb 1976. Filed date 19 Feb 1975. 4p.

PAT-APPL-551,200.

A beam profile analyzer employing sector or quadrant plates is described. Each plate is servo controlled to outline the edge of a beam.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 26361

26368 (LA-UR—76-1178) **Design of a π^0 spectrometer at LAMPF.** Heffner, R. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 8p. (CONF-760561—4). Dep. NTIS $3.50.

From International topical conference on meson-nuclear physics; Pittsburgh, Pennsylvania, United States of America (USA) (24 May 1976).

A discussion is given of the salient features for the design of a π^0 spectrometer being constructed at LAMPF. The basic concepts of π^0 detection are explained, and the expected performance and mechanical design of the instrument are discussed. A list of intended experiments to be undertaken is given. The spectrometer is intended to be used for pion-charge-exchange and production reactions with nuclear targets.

26369 (LBL—4826) **System for obtaining longitudinal beam polarization at PEP with vertical dipoles located outside of the interaction region.** Garren, A.; Kadyk, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1975. Contract W-7405-Eng-48. 6p. (PEP—184; CONF-750768—1). Dep. NTIS $3.50.

From PEP summer study; Berkeley, California, United States of America (USA) (28 Jul 1975).

An initial study of a beam polarization system was made: a "first look" at the configuration, not an optimized design. The feasibility of a system in which the large spin rotation magnets are located outside the IR (interaction region) is discussed. The system can, in principle, be turned on or off to allow conventional operation of PEP or operation with the SRS (spin rotation system). Operation over a wide energy range also appears possible without moving magnets, with only a relatively small loss in longitudinal polarization. The IR is left unencumbered by the SRS, and the sources of synchrotron radiation are moved out of the IR. However, a careful study is necessary to determine the best design for reducing or eliminating this background radiation.

STORAGE RINGS

REFER ALSO TO CITATION(S) 26372

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 25835

26370 (COO—1545-92) **Monte Carlo program for calculating neutron detection efficiencies in plastic scintillator.** Stanton, N.R. (Ohio State Univ. Research Foundation, Columbus (USA)). Feb 1971. Contract E(11-1)-1545. 96p. Dep. NTIS $5.00.

A FORTRAN IV Monte Carlo program to calculate the neutron detection efficiency of plastic scintillators of rectangular or cylindrical geometry as a function of neutron energy and light collection threshold has been written and tested. The existing cross-section data for neutron-carbon interactions have been adjusted to give a good fit to existing measurements of efficiency. This document contains a complete description of the physics input and method of approach, together with detailed instructions for use of the program. A listing of the source code, the data deck, and output of a sample calculation are appended.

26371 (EGG—1183-2336) **Fabrication of HgI_2 nuclear detectors.** Schieber, M. (EG and G, Inc., Santa Barbara, Calif. (USA)). Apr 1976. Contract E(29-1)-1183. 44p. (CONF-7506139—1). Dep. NTIS $4.00.

From Workshop on HgI2 detectors; Strassbourg, France (11 Jun 1975).

Methods of material purification and crystal growth of mercuric iodide (HgI_2), plus preparation and characterization of nuclear detectors fabricated from HgI_2 crystals, are reviewed. The state of the art of HgI_2 nuclear detector fabrication is assessed. The use of HgI_2 to detect low energy x rays of about 2 keV and its potential use for high energy gamma-ray detection of up to 662 keV, as seen from some preliminary ^{137}Cs gamma spectra, is discussed.

26372 (LA—6356-MS) **Scintillators and photomultipliers. Some tests for EPICS tune-up.** Kaellne, J.; Thiessen, H.A.; Obst, A. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1976. Contract W-7405-eng-36. 8p. Dep. NTIS $3.50.

Different scintillators and photomultipliers have been tested with respect to time and pulse height characteristics and their variation over the area of a large scintillator (60 x 15 x 0.64 cm). Using minimum ionizing particles we achieved a time resolution of 0.8 ns, a spatial resolution of 5.5 cm, and a pulse height resolution of about 15 percent (FWHM). Viewed from one end, the pulse height varied exponentially vs distance with a break at about 15 cm from the end. The pulse height variation across the scintillator was 10 percent for source positions closest to the viewed end.

RADIATION DOSEMETERS

REFER ALSO TO CITATION(S) 25879, 26755

26373 (COO—1105-227) **Fast neutron activation dosimetry with TLDS.** Pearson, D.W.; Moran, P.R. (Wisconsin Univ., Madison (USA). Medical Physics Labs.). 1975. Contract E(11-1)-1105. 119p. Dep. NTIS $5.50.

Fast neutron activation using threshold reactions is the only neutron dosimetry method which offers complete discrimination against gamma-rays and preserves some information about the

neutron energy. Conventional activation foil technique requires sensitive radiation detectors to count the decay of the neutron induced activity. For extensive measurements at low neutron fluences, vast outlays of counting equipment are required. TL dosimeters are inexpensive, extremely sensitive radiation detectors. The work of Mayhugh et al. (Proc. Third Int. Conf. on Luminescence Dosimetry, Riso Report 249, 1040, (1971)) showed that $CaSO_4$: DyTLDs could be used to measure the integrated dose from the decay of the radioactivity produced in the dosimeters by exposure to thermal neutrons. This neatly combines the activation detector and counter functions in one solid state device. This work has been expanded to fast neutron exposures and other TL phosphors. The reactions $^{19}F(n, 2n)^{18}F$, $^{32}S(n,p)^{32}P$, $^{24}Mg(n,p)^{24}$, and $^{64}Zn(n,p)^{64}Cu$ were found useful for fast neutron activation in commercial TLDs. As each TLD is its own integrating decay particle counter, many activation measurements can be made at the same time. The subsequent readings of the TL signals can be done serially after the induced radioactivity has decayed, using only one TL reader. The neutron detection sensitivity is limited mainly by the number statistics of the neutron activations. The precision of the neutron measurement is within a factor of two of conventional foil activation for comparable mass detectors. Commercially available TLDs can measure neutron fluences of $10^9 n/cm^2$ with 10 percent precision.

NUCLEAR SPECTROSCOPIC INSTRUMENTAION

26374 (BNL—21293) **Improvements and tests of the Bonner multisphere spectrometer.** Distenfeld, C.H. (Brookhaven National Lab., Upton, N.Y. (USA)). 1975. Contract E(30-1)-16. 58p. Dep. NTIS $4.50.

Neutron dosimetry or shielding studies require that energy spectra be specified. One may choose between assuming, calculating or measuring the pertinent energy spectra. Restricting consideration to neutron spectra measurements, energy resolution, and range requirements establish the spectrometry method. This study was performed to determine if the Bonner Multisphere Spectrometer can be used for determining smooth continuous spectra such as produced by reactor or accelerator neutron shield leakage. Neutron leakage spectra from thick soil or concrete shielding are assumed to be smooth and continuous. All appropriate constants, assumptions, definitions, response function and the unfolding code method are included to allay prejudice against the BMS as a viable neutron spectrometer.

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 26368, 26378

RADIOMETRIC INSTRUMENTS

REFER ALSO TO CITATION(S) 25269, 26340, 26387, 26393

26375 (MLM—2343(OP)) **Semi-automated x-ray gauging system with computerized data acquisition and documentaton.** Draut, C.F.; Homan,D.A. (Mound Lab., Miamisburg, Ohio (USA)). 1976. Contract E-33-1-GEN-53. 10p. (CONF-760726—1). Dep. NTIS $3.50.

From Joint automatic control conference; W. Lafayette, Indiana, United States of America (USA) (27 Jul 1976).

An x-ray gauging method was developed and a production gauging system was subsequently fabricated to control the quality of precision manufactured components. The gauging system measures via x-ray absorption the density of pressed finely divided solids held in a dissimilar container. The two dissimilar materials condition necessitated a "two scan" technique: first the x-ray attenuation (absorption) of the empty container prior to loading, and then, the attenuation of the loaded container are measured; that is, four variables. The system provided greatly improved product control via timely data feedback and increased product quality assurance via 100 percent inspection of product. In addition, it reduced labor costs, product cost, and possibilities for human errors.

26376 (PB—241440) **Field evaluation of a direct transmission type nuclear moisture-density gauge. Missouri cooperative highway research program (final).** (Missouri State Highway Dept., Jefferson City (USA). Div. of Materials and Research). Jan 1975. 24p. NTIS $3.25.

Results obtained by a nuclear moisture-density gauge were correlated to those obtained by a balloon type volume device and oven drying. The nuclear testing modes were direct transmission for wet density and backscatter for moisture. Comparison tests were made on active construction projects in each of 10 soil types and graded aggregate bases from 10 stone formations. The test sites were located throughout the state. The test results were analyzed statistically by regression, correlation coefficient and t test (comparison of the means). It was found that the manufacturer's wet density calibration curve provided acceptable results in all of the Missouri soil types and stone formations tested but that the manufacturer's water calibration curve frequently furnished unacceptable values for moisture content. However, acceptable moisture content values were obtained with the nuclear gauge by use of a computed correction factor. This factor was found to be a constant for a particular soil type or stone formation on a project. (GRA)

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 25865, 26340, 26411

26377 (AD-A—011313) **Construction of a balloon-borne rf quadrupole mass spectrometer package. Final report, 7 Dec 1972—31 Aug 1974.** Murcray, D.G.; Amme, R.C. (Denver Univ., Colo. (USA). Dept. of Physics and Astronomy). Jun 1975. Contract DAAD05-73-C-0139. 65p. NTIS $4.25.

A balloon-borne, radio-frequency mass spectrometer was constructed under this contract. The package is designed to study the ambient positive ion and more abundant neutral molecules of the upper stratosphere. The range of the mass spectrometer is 1 to 150 amu, with a resolution which can be set to better than 1 amu over that range. Titanium sublimation is used to pump the bulk of the gas load, with assistance from a liquid helium CO_2 frost pump. (GRA)

26378 (AD-A—012402) **Picture processing. Technical report.** Weszka, J.S.; Rosenfeld, A. (Maryland Univ., College Park (USA). Computer Science Center). May 1975. Contract N00014-75-C-0286. 51p. NTIS $4.25.

See also report dated Jan 1975, AD/A—004974.

This paper reviews the fundamentals of automatic picture processing and scene analysis. It discusses computer-based methods of segmenting pictures into meaningful parts; determining properties of the parts and relationships among the parts; and using this information to construct descriptions of the pictures. The material is organized by principal areas of application, including document reading, high-energy physics, cytology, radiology, and remote sensing of the environment. (GRA)

26379 (INIS-mf—3070) **A study of far-infrared Michelson interferometry based on fast plasma scanning.** Bartlett, D.V.; Hewitt, G.L.; Robinson, L.C.; Tait, G.D. (Sydney Univ. (Australia). School of Physics). Feb 1976. 43p. INIS.

Fast far-infrared multiplex spectroscopy based on a plasma-scanned Michelson interferometer is studied. Our experiments show that the interferometer has sub-millisecond time response and high spectral resolving power. In addition to a description of the experimental performance of the interferometer, we develop and discuss two different methods of interferogram inversion.

26380 (LA—6410-MS) **Description of model 73 telemetry system for reporting temperature and identification.** Bobbett, R.E.; Koelle, A.R.; Depp, S.W.; Freyman, R.W. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1976. Contract W-7405-ENG-36. 9p. Dep. NTIS $3.50.

An electronic identification and temperature monitoring system is described. This system, designated Model 73, was designed and fabricated in 1973 to demonstrate the feasibility of implementing a technique which is based on a passive transponder which responds to interrogation by a transmitter operating in the L-band radar frequencies. The purpose of this report is to document the functional elements of this successful preprototype system.

26381 (LA-UR—76-623) **Portable flash x-ray systems: applications and techniques.** Bryant, L.E. Jr. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 9p. (CONF-760903—1). Dep. NTIS $3.50.

From 8. world conference on nondestructive testing; Cannes, France (6 Sep 1976).

Three energies of portable flash x-ray equipment are described, and applications such as jetting and high explosive studies, bullet impact and casting of lead experiments are given as well as techniques for triggering and protection of equipment and film.

26382 (MLM—2338(OP)) **Microprocessors in process control applications.** Koehler, F.A. Jr.; Anderson, B.E. (Mound Lab., Miamisburg, Ohio (USA)). 1976. Contract E-33-1-GEN-53. 7p. (CONF-760827—1). Dep. NTIS $3.50.

From Monsanto process computer symposium; Pensacola, Florida, United States of America (USA) (8 Aug 1976).

Monsanto Research Corporation has developed a modular based process control system utilizing a Motorola M6800 microprocessor. A microprocessor is being installed in a process at Mound Laboratory that requires the monitoring and control of very low flow rates in the ranges of 1 to 3 cm^3/min of liquid and 3 to 6 liters/min of gas. To monitor the liquid flow, a "hot wire" technique is employed. A special order turbine flowmeter is used for the gas monitoring. Since this is a controlled process, it was necessary to develop a proportional control valve that would give reasonable control of flow in the 1 to 3 cm^3/min range. A direct digital control valve was built and is presently being installed in the process. The entire process control system is completely constructed with off-the-shelf hardware and is interfaced with a commercially available multiplexer. Finally, the microprocessor system is easily adaptable, and permits a user to configure a process control system according to his immediate requirements.

26383 (SAND—75-6154) **Intrinsic thermocouple measurement errors.** Keltner, N.R.; Bickle, L.W. (Sandia Labs., Albuquerque, N.Mex. (USA); New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering). 1975. 24p. (CONF-760816—4). Dep. NTIS $3.50.

From National heat transfer conference; St. Louis, Missouri, United States of America (USA) (8 Aug 1976).

An approximate analytical model is given for the transient response of an intrinsic thermocouple. Thermocouple response charts are developed. The model is used with numerical convolution and deconvolution to estimate and correct for transient temperature measurement errors. The methods are illustrated by example applications.

26384 (UCRL—52000-76-4, pp 8-11) **Moving, three-dimensional holograms: a new computer graphics display.** Apr 1976.

In Energy and technology review.

Computer programs for making perspective drawings of three-dimensional objects have existed for years. A new holographic technique now permits these two-dimensional drawings to be displayed as three-dimensional objects that rotate and change shape. The information conveyed by these holograms is more accurate than that from a solid model, with the added advantages that they can be animated, can shrink or grow, and can be produced far more quickly and inexpensively. Examples include graphs of multidimensional data and animated crystal and molecular structure models. 2 figures.

26385 Method for biological testing of containment systems for viral agents. Bolton, N.E.; Lincoln, T.A.; Otten, J.A.; Porter, W.E. (Oak Ridge National Lab., TN). *Am. Ind. Hyg. Assoc. J.*; **37**: No. 7, 427-431(Jul 1976).

A technique utilizing coliphage as the test material has been developed and employed to evaluate the effectiveness of a containment system for zonal centrifugation of hepatitis viruses. An Andersen Viable Particle Sampler which had been loaded with plates containing a base layer of agar nutrient with an overlay of E. coli-agar suspension was used to sample the test air. The containment system, which includes a HEPA filter, was challenged with an aerosolized suspension of coliphage.

WELL LOGGING INSTRUMENTATION

26386 Methods for thermal well logging. Smith, H.D. Jr. (to Texaco Inc.). US Patent 3,892,128. 1 Jul 1975. Filed date 6 Aug 1973. vp.

The ambient borehole temperature at a particular depth is recorded, and then the specific heat is determined by measuring the temperature as a constant output source heats the formation. The temperature decrease with time is measured after the heat source is removed, and the thermal conductivity is calculated.

26387 Well-logging method using well-logging tools run through a drill stem test string for determining in-situ change in formation water saturation values. Fertl, W.H. (to Continental Oil Co.). US Patent 3,895,520. 22 Jul 1975. Filed date 27 Jul 1973. vp.

A logging tool (pulsed neutron or neutron-gamma ray) whose response indicates formation water saturation value, is run through an opening extending through a portion of a drill stem test string. A sample portion of the formation fluid in the zone of interest is removed and another logging run is made. The differences between the plots of the two logging runs indicate the formation potential productivity in the zone of interest.

26388 Method and apparatus for logging the course of a borehole. Rohr, U. (to Deutsche Texaco Aktiengesellschaft). US Patent 3,896,412. 22 Jul 1975. Filed date 19 Nov 1973. vp.

A special computer circuit at the surface receives signals indicative of the borehole angle of inclination, azimuth angle, and the rate of descent of the logging tool and calculates the course of the borehole.

26389 Permeability logging method using apparatus comprising current electrodes between electromagnets, current electrode on the surface, and acoustic listening devices to detect pressure-related noise. Dowling, D.J. (to Texaco Inc.). US Patent 3,896,413. 22 Jul 1975. Filed date 28 Jan 1974. vp.

The permeability next to a borehole is measured by recording the wideband acoustic noise generated by the electrokinetic flow of fluids in the formation. The sonde, which includes magnetic poles and a dc current electrode, imparts electrokinetic energy to the molecules of the fluid.

26390 Methods and apparatus for determining characteristics of subsurfaces earth formations. Anderson, R.A. (to Schlumberger Tech. Corp.). US Patent 3,896,668. 29 Jul 1975. Filed date 5 Oct 1973. vp.

Well-logging measurements of bulk density and compressional wave traveltime, corrected for the presence of hydrocarbons, determine the shaliness index, which is used to compute Poisson's ratio. Elastic constants such as shear and bulk moduli are calculated, using a computer, to identify mechanically competent formations.

26391 Method and apparatus for measuring pressure-related parameters. McArthur, B.W. (to Sperry-Sun Well Surveying Co.). US Patent 3,898,877. 12 Aug 1975. Filed date 8 Nov 1973. vp.

Pressure in a well is measured by forcing fluid from the surface through a tube into an upper bellows which forces the fluid in the chamber outside the upper bellows through an annular channel into a lower bellows in contact with the fluid in the well. The rate of pressure build-up of the fluid at the surface is monitored.

26392 Acoustic permeability log utilizing differential traveltime measurements. Dowling, D.J. (to Texaco, Inc.). US Patent 3,900,826. 19 Aug 1975. Filed date 31 Oct 1973. vp.

Two high-intensity pulsed acoustic (50 to 500 hz) sources, one above the other in a fluid-filled borehole, which are 180^0 out-of-phase push fluid in and out of the formation near the borehole. The difference of the formation ultrasonic velocities measured with and against the fluid flow is related to the permeability of the formation.

26393 Methods and apparatus for measuring the density of geologic formations. Seeman, B. (to Schlumberger Tech. Corp.). US Patent 3,900,733. 19 Aug 1975. Filed date 24 Jan 1973. vp.

The count rate of pulses detected with a gamma-ray density logging tool is corrected for the effects of the barite contained in the borehole mudcake by adjusting the threshold or minimum energy level.

26394 Methods of preventing cycle skipping in processing acoustic well-logging signals. Trouiller, J.C. (to Schlumberger Tech. Corp.). US Patent 3,900,824. 19 Aug 1975. Filed date 16 Feb 1973. vp.

The last transit time taken with a slowly moving acoustic logging tool is recorded if the difference between the last two transit time measurements is less than $^3/_4$ of the average period of the acoustic waves. The previous transit time is again recorded and the gain applied to the received signal remains at its former value, if the difference between the transit times is greater than this threshold.

EXPLOSIONS AND EXPLOSIVES

26395 (AD-A—011225) **Results of RFI testing of Safeguard flexible tunnel section. Final report.** Leverenz, D.J.; McCormack, R.G.; Nielsen, P.H. (Army Construction Engineering Research Lab., Champaign, Ill. (USA)). May 1975. 24p. (CERL-TR-C—16). NTIS $3.25.

The report discusses results of the RFI shielding-effectiveness testing of a portion of the flexible tunnel section used for joining the equipment tunnels to the linear plate of the SAFEGUARD shielded enclosures. Test results are presented for several modifications to the tunnel section, including the mounting configuration to be used on site. These results indicate that, for most configurations, the shielding effectiveness of the tunnel section does meet the SAFEGUARD EMP specifications. Thus, the choice of configuration and material can be selected for construction convenience. (GRA)

CHEMICAL

REFER ALSO TO CITATION(S) 26668

26396 (LA—6417-MS) **Field distortion switch for electrically driven flying plate experiments.** Conant, J.W.; Lynch, M.T.; Patterson, W.W.; Ware, K.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1976. Contract W-7405-eng-36. 7p. Dep. NTIS $3.50.

The use of a field distortion switch in electrically driven flying plate research is described. The switch can be triggered in a range from 1 to 60 kV with a voltage rise time of 15 to 20 ns. The current quarter period of 2 μs remains the same over this voltage range because the electrode geometry is not changed. Dry air is used to bathe the electrodes when operating in the range from 9 to 60 kV. Argon is used in the 1 to 10 kV range.

26397 (LA-UR—76-986) **High-temperature EBW detonators.** Dinegar, R.H.; Carlson, L.A.; Coburn, M.D. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 7p. (CONF-760805—17). Dep. NTIS $3.50.

From 6. symposium on detonation; San Diego, California, United States of America (USA) (24 Aug 1976).

A high-temperature-resistant exploding bridgewire detonator is described. The explosive is BTX, which shows no exotherm below the melting point 263°C, and is stable in vacuum stability tests at a temperature exposure of at least 175°C for 90 days. The energy required is higher than is used for PETN detonators. Design studies are being made.

26398 (LA-UR—76-997) **Perpendicular explosive drive and oblique shocks.** Neal, T. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 11p. (CONF-760805—4). Dep. NTIS $3.50.

From 6. symposium on detonation; San Diego, California, United States of America (USA) (24 Aug 1976).

Oblique shocks in various materials driven by Composition B-3, 9404, and TNT with the detonation wave perpendicular to the interface are investigated with flash radiographic techniques. The detonation products in the rarefaction behind the detonation front expand laterally as the explosive-sample interface bends under shock compression of the sample. With the products described by a polytropic gas equation of state, this expansion is shown to be adequately described in the vicinity of the detonation front by Prandtl-Meyer flow. Some new Hugoniot data for antimony are obtained in the course of the investigation. In some instances of perpendicular drive the compression of the sample is not accomplished strictly by strong shocks. This circumstance is exemplified by baratol driving aluminum, a case where the bulk sound speed exceeds the detonation velocity, and by 9404 driving beryllium, a case where it does not. Some experimental results are presented for both these systems.

26399 (LA-UR—76-1115) **Diameter effect in high-density heterogeneous explosives.** Campbell, A.W.; Engelke, R. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 12p. (CONF-760805—16). Dep. NTIS $3.50.

From 6. symposium on detonation; San Diego, California, United States of America (USA) (24 Aug 1976).

A phenomenological study of the dependence of steady detonation velocity on charge radius (the "diameter effect") in cylindrical configuration is described. Consideration is mainly given to high-density heterogeneous solid explosives cast or pressed to greater than 94 percent of theoretical maximum density. The work centers around a new fitting form which fits data for both homogeneous and heterogeneous explosives quite well. Some success is achieved in correlating the parameters of the fit with measured quantities. The effect of joints in rate sticks and of boosting on steady detonation velocity is examined experimentally. A significant joint effect is resolved. Finally, front-curvature measurements on a plastic bonded TATB are used to deduce the reaction-zone length for this explosive. Comparisons are made with zone lengths obtained by other methods.

26400 (LA-UR—76-1174) **Hydrostatic compression of explosives and detonation products to 10 GPa (100 kbars) and their calculated shock compression: results for PETN, TATB, CO_2, and H_2O.** Olinger, B.W.; Cady, H.H. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 10p. (CONF-760805—6). Dep. NTIS $3.50.

From 6. symposium on detonation; San Diego, California, United States of America (USA) (24 Aug 1976).

The isothermal linear and volume compressions of PETN, TATB, CO_2, and H_2O are determined from x-ray diffraction patterns taken at hydrostatic pressures up to 10 GPa. From the compressions the Hugoniots of these materials are calculated assuming that the heat capacity at constant volume and the ratio of the Grueneisen constant to the specific volume both remain constant over the 10 GPa pressure range studied here. The Hugoniots in shock-particle velocity coordinates centered at 0 GPa, 293°K, are given.

26401 (LA-UR—76-1201) **Shock initiation of high-density PETN.** Wackerle, J.; Johnson, J.O.; Halleck, P.M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 10p. (CONF-760805—5). Dep. NTIS $3.50.

From 6. symposium on detonation; San Diego, California, United States of America (USA) (24 Aug 1976).

The prompt (1- to 3-μs), planar shock initiation of 1.75-g/cm³ (98.4 percent crystal density) pentaerythritol tetranitrate (PETN) has been studied with impact-generated shocks and observations with the explosive wedge technique and quartz and embedded-Manganin pressure-gauge measurements. Dynamic compression properties, shock buildup to detonation, and pressure-field histories during initiation were determined. An analysis of the latter data show that shock-induced decomposition begins near the impact surface, forming a pressure pulse that in turn produces a compression wave that overtakes the shock front and effects the shock to detonation transition. Maxima in the pressure are interpreted to be due to sudden and spontaneous decreases in reaction rate when only partial decomposition has occurred. Implications of this interpretation and possible errors that could invalidate it are discussed.

26402 (LA-UR—76-1518) **Perturbation methods applied to problems in detonation physics.** Bdzil, J.B. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-eng-36. 18p. (CONF-760805—18). Dep. NTIS $3.50.

From 6. symposium on detonation; San Diego, California, United States of America (USA) (24 Aug 1976).

A theoretical study of an explosive which releases a small fraction of its total energy via resolved reactions is presented. Two separate problems are treated. First a time-dependent one-dimensional unsupported detonation is considered. It is shown that the detonation is a reactive simple wave. The particle velocity profiles are calculated for a model explosive. Second, the detonation edge effect for a steady-state semi-infinite unconfined detonation is considered. It is shown that the near-field flow is dominated by the Prandtl—Meyer singularity, whereas the far-field flow is controlled by the reactivity and streamline divergence. The shock locus, sonic locus, and limiting characteristic are calculated and the effects of confinement are discussed.

26403 (MHSMP—76-13) **Comparison of Pantex high purity HNS I to a Chemtronics HNS I for their sensitivity to initiation by HNS II MDF. Final report.** Hanes, L.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Apr 1976. Contract DA-11-173-AMC-487(A). 15p. Dep. NTIS $3.50.

For Sandia Labs., Albuquerque, NM.

Two lots of HNS I have been compared for their sensitivity to initiation by an HNS II MDF donor. The sensitivity test utilized was previously developed to study the excess transit time for transfer of detonation from a small diameter confined donor to a larger diameter unconfined acceptor via the detonation electric effect technique.

26404 (MHSMP—76-15B) **Effects of thermal aging on the mechanical properties of RX-03-BB. Period covered: January—March 1976.** Johnson, H.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. Contract DA-11-173-AMC-487(A). 5p. (SANL—458-002). Dep. NTIS $3.50.

A study was conducted to determine the effects of thermal aging on the mechanical properties of RX-03-BB Blend 7. The heat-treated and control specimens strain-at-failure in tension were 0.28 and 0.36 percent, respectively. The heat-treated specimens produced an average diameter growth of 1.25 mm/m.

26405 (MHSMP—76-17D) **Assay of nitroplasticizer for PBX 9501. Period covered: January—March 1976. Normal process development endeavor No. 105.** MacDougall, C.S. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. 13p. Dep. NTIS $3.50.

A series of standard procedures for component and contaminant analysis of the nitroplasticizer in PBX 9501 was checked for accuracy and precision. Acid number was determined by a titration with methanolic KOH. Water was assayed by a Karl Fisher titration. The refractive index was measured at 25°C by a refractometer, and density was determined by a pycnometer. The BDNPA/BDNPF was assayed by a liquid chromatographic technique. A gas chromatographic method was developed for determination of ethanol. The antioxidant was measured by a spectrophotometric method.

26406 (MHSMP—76-17-O) **Bonding compatibility of Uralite 3121S adhesive with the MC 3125. Period covered: January—March 1976. Normal process development endeavor No. 202.** Montague, J.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. 7p. Dep. NTIS $3.50.

Hexcel Uralite 3121S is recommended as an adhesive for assembly of the MC 3125. Surface preparation, assembly process, curing, and strength characteristics needed for assembly were evaluated.

26407 (MHSMP—76-17P) **ALSC cutter. Period covered: January—March 1976. Normal process development endeavor No. 202.** Schmitz, G.T. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. 10p. Dep. NTIS $3.50.

Aluminum sheath linear shaped charge (ALSC) containing HNS-II core explosive was specified as the explosive component in the MC 3125 design. Technology and tooling for cutting and forming ALSC, HNS II, 5.3 g/m core load, are described as preliminary developments to the manufacturing process.

26408 (MHSMP—76-17R) **Skid test evaluation of PBX 9407. Period covered: January—March 1976. Normal process development endeavor No. 216.** Van Velkinburgh, J.H. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. 5p. Dep. NTIS $3.50.

Skid testing was done on PBX 9407 (nominal composition 94/6 RDX/Exon 461 by weight) to determine its sensitivity. Sensitivity of PBX 9407 appears to be similar to that of LX-04-1.

26409 (MHSMP—76-17T) **Comprehensive examination of silicone membrane materials from W68. Period covered: January—March 1976. Normal process development endeavor No. 223.** Graff, M.E.; MacDougall, C.S. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. 13p. Dep. NTIS $3.50.

Proper performance of the W68 depends, among other factors, upon a functional silicone membrane. It is known that the LX-09 releases deleterious products which may be incompatible with other components of the system. If the chemistry of decomposition of the membranes can be clearly elucidated, preventive measures may be taken in system construction to optimize shelf lives of the units. Therefore, a project was initiated to examine this decomposition. Initially, several key tests were performed. These included: (1) toluene swell, (2) thermogravimetric analysis, (3) ionic fluoride determination and total fluoride assay, (4) total amine analysis, (5) total acrylate determination, and (6) functional group analysis of extractables. The results of analyses on W68 membranes are compared with control assays of membranes in units not containing the LX-09.

26410 (MHSMP—76-17V) **Determination of the molecular weight of the nitrocellulose binder in PBX 9404. Period covered: January—March 1976. Normal process development endeavor No. 223.** Blythe, R.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. 8p. Dep. NTIS $3.50.

A method has been developed for making molecular weight determinations of the nitrocellulose binder in PBX 9404. A 3 percent sample of PBX 9404 in tetrahydrofuran (THF) is analyzed by gel permeation chromatography (GPC). Molecular weights were calculated in the classical manner.

26411 (MHSMP—76-17X) **Resistive wire velocity probe. Period covered: January—March 1976. Normal process development endeavor No. 231.** Campos, C.A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. 21p. Dep. NTIS $3.50.

The resistive wire technique used for measuring detonation velocity is discussed and a few results presented to report the progress. To implement the technique a thorough investigation was performed to reveal any areas which might introduce errors in the results. Tests with lead sheathed PETN/MDF and RDX/ALSC reveal irregularities in the detonation burn. They appear as rising and falling values in velocity with respect to time. Work has concentrated on reduction of electrical noise, identification of instrumentation errors and improvements in data reduction. Future work will apply this knowledge to the study of high explosive detonation velocities.

26412 (MHSMP—76-17Y) **Evaluation of the use of dry nitrogen to increase photographic film speed. Period covered: January—March 1976. Normal process development endeavor No. 231.** Van Velkinburgh, J.H. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. 14p. Dep. NTIS $3.50.

The utility of prolonged storage of photographic film under a dry nitrogen atmosphere to increase speed was investigated. Differences between nontreated and nitrogen treated Kodak Tri-X and Royal-X are discussed.

26413 (MHSMP—76-17Z) **Detonation pressure measurement with aquarium tests. Period covered: January—March 1976.** Kramer, P.E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1976. Contract DA-11-173-AMC-487(A). 5p. Dep. NTIS $3.50.

Many of the technical problems of applying the detonation electric effect to aquarium tests were solved but additional tests are required to determine if the method is operational. In the meantime, questions about the aquarium test itself have arisen which will require investigation.

26414 (MLM—2280) **MC2990: development of a helium leak tight header.** Weyler, F.W.; Taulbee, A.C. (Mound Lab., Miamisburg, Ohio (USA)). 30 Jul 1976. Contract E-33-1-GEN-53. 11p. Dep. NTIS $3.50.

All of the development efforts expended on establishing a fabrication process for the MC2990 sealed header are described. Effects of molding pressure and temperature are discussed. Helium leak test data are presented for various header configurations. The header molding process as developed in this effort has resulted in an acceptance rate greater than 90 percent.

26415 (UCID—17192) **Energy deposition in TATB by electrons at 50 and 100 MeV.** Carson, J.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jun 1976. Contract W-7405-Eng-48. 13p. Dep. NTIS $3.50.

Since energy deposition by electron beams is almost instantaneous, deposition profiles can be used to effectively calculate the impulse delivered by the electron energy deposition within a material. Electron deposition also produces thermal effects that can sensitize certain targets. These two factors, along with the fact that high explosives will thermally or shock initiate, leads to interest in the effects produced by impinging electron beams on high explosives. Results of calculations made for a 0.1 cm^2 electron beam source directed perpendicular to the high explosive surface are presented. The H.E. chosen in these calculations was TATB, a new shock insensitive explosive. Findings, however, are representative of what would be found in other high explosives had they been used. Two incident electron beam energies were chosen for this work, 50 and 100 MeV. Both electron sources were considered to be monoenergetic as input to the Monte Carlo electron/photon transport code SANDYL.

26416 (UCRL—50016-76-1, pp 4-6) **Slapper: a new kind of detonator.** Stroud, J.R. 31 Mar 1976.

In Mechanical Engineering Department quarterly report, January—March 1976.

A new kind of detonator that operates by exploding a thin metal foil, which accelerates a plastic film across a gap to impact on a high-density secondary explosive is described. It offers advantages of enhanced safety, resistance to environmental extremes, and inexpensive construction. Its main disadvantage is the large power supply required, but firing units of reasonable size have been built and demonstrated.

NUCLEAR

26417 (AD-A—011288) **Aeroloading and dynamics of a conical vehicle during pentration of a blast wave. Final report, 1 Jan—31 Mar 1974.** Dunn, J.R.; Barbin, A.R.; Vachon, R.I. (Auburn Univ., Ala. (USA)). Apr 1974. Contract DAHC60-71-C-0076. 26p. NTIS $3.75.

The procedure for predicting transient loads on a conical vehicle during the oblique penetration of a blast induced shock wave is discussed. The importance of this analysis is in the application of the predicted aerodynamic loads to estimate the dynamic response of the missile during the blast penetration transient.

26418 (CONF-760919—1) **Automatic pelletizing system for pyrotechnic materials.** McCloskey, E.J. (Mound Lab., Miamisburg, Ohio (USA)). 1976. Contract E-33-1-GEN-53. 20p. Dep. NTIS $3.50.

From 17. DOD explosives safety seminar; Denver, Colorado, United States of America (USA) (14 Sep 1976).

An automatic system for producing pellets from blends of finely divided pyrotechnic materials and DAP (diallyl phthalate) plastic is described. Operational restrictions imposed by the hazardous nature of pyrotechnics are met with equipment powered with air and controlled in operational sequence with airlogic circuits. The process consists of moving the blend from a hopper to a cavity where it is pressed into a pellet, which is subsequently ejected. The pellets are used as preforms for a molding process. The automatic pelletizing system provides improvement in safety, production rate, and product consistency over the manual system it replaced.

26419 (UCRL—50016-76-1, pp 11-16) **Gas-initiated crack propagation in a permeable earth formation.** Pitts, J.H.; Brandt, H. 31 Mar 1976.

In Mechanical Engineering Department quarterly report, January—March 1976.

A three-dimensional computer analysis of crack propagating through a permeable earth formation as a result of an underground nuclear explosion was developed. It includes interaction of gas pressure within the crack, gas permeation into the earth formation, crack wall deflection, and crack propagation. The analysis shows that a crack produced by an explosion at 500 m will not propagate to the earth's surface unless the earth permeability and the ratio of maximum resistive pressure to driving pressure are both unusually low.

WEAPONRY

26420 **Multiple switch actuator.** Beyer, E.T. (to Energy Research and Development Administration). US Patent 3,931,488. 6 Jan 1976. Filed date 20 Jun 1950. 4p.

PAT-APPL-169,241.

The invention described relates to switches and switch actuating devices to be operated for purposes of arming a bomb or other missile as it is dropped or released from an aircraft. The particular bomb or missile in which this invention is applied is one in which there is a plurality of circuits which are to be armed by the closing of switches upon dropping or releasing of the bomb. The operation of the switches to closed position is normally accomplished by means of a pull-out wire; that is, a wire which is withdrawn from the bomb or missile at the time of release of the bomb, one end of the wire being attached to the aircraft. The conditions to be met are that the arming switches must be positively and surely maintained in open position until the bomb is released and the arming action is effected. The action of the pull-out wire in achieving the arming action must be sure and positive with minimum danger of malfunctioning, jamming, or binding.

EXPLOSION DETECTION

26421 (AD-A—011370) **Determination of seismic source depths from differential travel times. Quarterly report, 1 Nov 1974—31 Jan 1975.** Page, E. (Ensco, Inc., Springfield, Va. (USA)). May 1975. Contract F08606-75-C-0025. 15p. NTIS $3.25.

The objective of the project described is to improve seismic depth phase detection by exploiting information contained in the seismic coda. A well-understood event was analyzed, and it was demonstrated that depth phase detection can be enhanced through proper analysis of the seismic coda. How a cepstrum matched filter technique can automate the interpretation of the computed cepstrum and extract depth phase estimates is also discussed.

26422 (N—75-20919) **Study of the characteristics of seismic signals generated by natural and cultural phenomena.** Goforth, T.T.; Rasmussen, R.K. (Teledyne Industries, Inc., Garland, Tex. (USA). Geotech Div.). 1974. Contract NAS1-11889. 71p. (NASA-CR—132606). NTIS $4.25.

Seismic data recorded at the Tonto Forest Seismological Observatory in Arizona and the Uinta Basin Seismological Observatory in Utah were used to compare the frequency of occurrence, severity, and spectral content of ground motions resulting from earthquakes, and other natural and man-made sources with the motions generated by sonic booms. A search of data recorded at the two observatories yielded a classification of over 180,000 earthquake phase arrivals on the basis of frequency of occurrence versus maximum ground velocity. The majority of the large ground velocities were produced by seismic surface waves from moderate to large earthquakes in the western United States, and particularly along the Pacific Coast of the United States and northern Mexico. A visual analysis of raw film seismogram data over a 3-year period indicates that local and regional seismic events, including quarry blasts, are frequent in occurrence, but do not produce ground motions at the observatories comparable to either the large western United States earthquakes or to sonic booms. Seismic data from the Nevada Test Site nuclear blasts were used to derive magnitude-distance-sonic boom overpressure relations. (Author) (GRA)

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

REFER ALSO TO CITATION(S) 26509

BASIC STUDIES

REFER ALSO TO CITATION(S) 25705, 25917, 25940, 26450

26423 (COO—1340-49) **Problems in general circulation research and long-range weather forecasting.** Reiter, E.R. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). 1976. Contract E(11-1)-1340. 37p. (CONF-760553—2). Dep. NTIS $4.00.

From International school of atmospheric science; Erice, Trapani, Sicily, Italy (16 May 1976).

The vacillatory behavior of the atmospheric energy cycle in the northern hemisphere is discussed in some detail. A mid-winter dip in zonal available potential energy (AZ) of variable duration and date of occurrence has been tied to the development of blocking anticyclones in the Pacific and Atlantic. A 22 to 24-day vacillation in the atmospheric energy modes has been identified.

26424 (COO—1340-50) **General circulation of the atmosphere and weather in the Mediterranean.** Reiter, E.R. (Colorado State Univ., Fort Collins (USA)). 1976. 30p. (CONF-760553—1). Dep. NTIS $4.00.

From International school of atmospheric science; Erice, Trapani, Sicily, Italy (16 May 1976).

The occurrence of mistral winds in the Mediterranean shows a correlation with blocking activity over the eastern Atlantic. Apparently for this reason periods with a "midwinter dip" in the zonal available potential energy of the northern hemisphere are favored by mistral occurrence. There also is a tendency for a 22- to 26-day cycle to appear in pressure gradients at the 500- and 100-mb surfaces along the southern coast of France. Such pressure gradients, if they exceed a certain magnitude, are indicative of mistral episodes.

26425 (COO—2455-10) **Turbulent diffusion in linear shear flow.** Kao, S.K.; Doran, J.C. (Utah Univ., Salt Lake City (USA)). Jan 1976. Contract E(11-1)-2455. 13p. Dep. NTIS $3.50.

An analysis of the characteristics of the eddy diffusivity is made, and the equation for turbulent diffusion in a linear flow is derived. This diffusion equation is solved analytically. (auth)

26426 (ISWS/RI—81/75) **Studies of selected precipitation cases from METROMEX.** Changnon, S.A.; Semonin, R.G. (eds.). (Illinois State Water Survey, Urbana (USA)). 1975. Contract E(11-1)-1199. 333p. Dep. NTIS $10.00.

The primary goal of these case studies was to focus the entire METROMEX field and research effort by attempting to define better the various urban factors leading to measurable changes in rainfall and severe weather in the St. Louis area. Nine cases (rain periods lasting usually 12 to 24 hours) were chosen to represent a variety of summer precipitation conditions in the St. Louis area. This report is organized to present the cases in their chronological order. Five of the cases are from a 7-day period in August 1973 and include a case with relatively small air mass showers and a very complex day with a relative severe squall line system followed by a cold frontal rain system. Other cases were chosen from August 1972 and July 1973. Since the majority of the summer precipitation in the St. Louis area is associated with squall lines, cold fronts, and squall areas, it is not surprising that the frequency of these synoptic events dominates the case studies. Two air mass situations are reported, one dealing with a post cold-frontal thunderstorm and the other with warm sector showers. Six squall lines are studied, two of which were associated with frontal systems and four in which no front impacted on the storm situation. Studies of a cold frontal passage and its associated precipitation and of a squall area with no front in the vicinity are also included.

26427 (TID—27083) **METROMEX 1975. A summary report including a review of operations conducted by Atmospherics Incorporated during the period 1971—1975.** Henderson, T.J.; Duckering, D.W. (Atmospherics, Inc., Fresno, Calif. (USA)). 5 Mar 1976. Contract AT(11-1)-1199. 77p. Dep. NTIS $5.00.

For Illinois State Water Survey, Urbana, IL.

Project METROMEX has been a multi-agency research program involving an investigation of inadvertent weather modification at St. Louis, Missouri. The overall research goals for Project METROMEX are: To identify the effects of urbanization on the frequency and intensity of various aspects of atmospheric behavior, among them precipitation production and related severe weather; to identify the factors of urbanization which are causative agents of the observed effects, with a view to the possibilities for purposeful manipulation and management of these factors in the future; to identify the physical processes of the atmosphere through which the observed effects are produced, and to begin assessment of the present-day nature and magnitude of the impact of these modifications to atmospheric behavior on the wider environment-related issues of society. Data obtained through 1975 are reported. (CH)

26428 Estimates of nitric oxide production for lifting spacecraft reentry. Park, C. (Ames Research Center, Moffett Field, CA). *Atmos. Environ.*; **10**: No. 4, 309-313(1976).

An approximate analysis to estimate the quantity of nitric oxide that could be formed in the wake of a reentering lifting spacecraft is reported. Three different approaches are undertaken: two simplified analytical models utilizing the sudden-freezing concept named the "trailing-edge-freezing" and "wake-freezing" approximations, and a computer calculation involving numerical integration of chemical rate equations. The three methods predict a maximum nitric oxide production equivalent to 6, 9.5 and 8 percent of the mass of the spacecraft, respectively. Thus, the amount of nitric oxide expected to be produced by future space activities is negligibly small compared with that produced by the natural processes.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 25199, 25200, 25214, 25282, 25299, 25337, 25345, 25493, 25541, 25683, 25706, 25708, 25709, 25710, 25711, 25712, 26012, 26187, 26319, 26360, 26509, 26522, 26558

26429 (COO—1199-51) **Study of air pollution scavenging. Fourteenth progress report.** Semonin, R.G. (Illinois State Water Survey, Urbana (USA)). Apr 1976. Contract E(11-1)-1199. 26p. Dep. NTIS $4.00.

The field experiments were continued to estimate convective storm particulate scavenging efficiency in proximity to the St. Louis, Missouri urban-industrial complex. Complementary studies of the urban aerosol characterization, source strength, and removal processes were also studied. The 1975 field effort shifted emphasis from the immediate St. Louis area to the Alton-Wood River industrial complex. Along with the change in size and configuration of the network, there were increases in the numbers of most types of samplers. The new network yielded the following types of samples for analysis and interpretation: 1065 total rain samples from 85 sites; 68 sequential rainwater samples from 2 locations; 272 wet/dry samples from 7 locations; 216 air filter samples from 7 locations; 36 air filter samples from aircraft; and raindrop spectrometer data from 11 sites for the period 17 June-18 August. The analysis procedures require that all water samples undergo filtering for separate analyses of soluble and insoluble fractions of the elemental concentrations. This data collection effort provided a record number of samples for chemical analysis. Approximately 4000 pibals and over 370 radiosondes were released in the operational period, providing wind and thermodynamic data on 33 days. Aircraft missions were flown on 24 days, with one air tracer release of cesium on 19 July 1975. The status of the analysis of all types of data is described.

26430 (EPA—450/2-76-006) **State air pollution implementation plan. Progress report, July 1—December 31, 1975.** (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Office of Air Quality Planning and Standards). Apr 1976. 65p. NTIS.

This report features two topics: the current evaluation of all State Implementation Plans (SIPs) to determine by July 1, 1976, those that are substantially inadequate and need revisions to attain and maintain the National Ambient Air Quality Standards (NAAQS); and an overview of EPA's carbon monoxide/oxidant control strategies, with an emphasis on control of transportation-related sources of these pollutants. Also included in this report are summaries of SIP-related actions published in the Federal Register during this reporting period, ambient air quality and trend data for 1974, and stationary source compliance information. Since the last report in this series (EPA-450/2-75-008, September 1975), the number of major sources identified has increased by 2,463 to 21,823; 84 percent of these are now in compliance with an emission standard or on an acceptable compliance schedule.

26431 (INIS-mf—3030) **Air pollution health effects of electric power generation. A literature survey.** (Norwegian Inst. for Air Research, Kjeller; Institutt for Atomenergi, Kjeller (Norway)). Nov 1975. 180p. INIS.

163 references.

Institutt for Atomenergi (IFA) and Norsk Institutt for Luftforskning (NILU) have undertaken a joint project with the ultimate purpose of comparing the relative air pollution health effects of gas-fired, oil-fired and uranium-fueled electric power generating plants. Phase I of the project includes a literature review on pollutant emissions and their health effects. The methods which have previouously been used to compare the relative health effects are also reviewed. The radioactive effluents from nuclear power plants are tabulated and the health effects discussed on the basis of data from Hiroshima and Nagasaki, medical irradiation therapy and studies of USAEC and UKAEA employees. It is pointed out that there is no indication that chronic low-level radiation has somatic effects, and the Japanese data gives no conclusive indication of genetic effects. Background irradiation in Kerala and Guarapari and in USA is also cited. Following a brief presentation of the principal air pollutants from fossil fuels a number of studies of 'smog' incidents in the UK and USA are discussed, and a prediction equation based on multiple regression analysis is presented. Finally the methods of comparing the health effects from nuclear and fossil-fuel plants are discussed. In an appendix Lave and Freeburg's study 'Health effects of electricity generation from coal, oil and nuclear fuel' is evaluated.

26432 (LSU-SG—73-01, pp 233-236) **Relative changes in n-alkane composition in surface water slicks.** LaRock, P.A.; Ahlfeld, T.E. (Florida State Univ., Tallahassee). 1973.

In Microbial degradation of oil pollutants.

Samples of surface slicks were obtained in Bartaria Bay, Louisiana, and changes in n-alkane composition were determined. A table is presented to show relative concentrations at various sample locations. The general trend shows alkanes with a chain length between C-17 and C-20 to be relatively unchanged, whereas C-14, C-16, and C-21 to C-32 show net decreases moving toward the south. This decrease amounted to 50 to 88 percent for alkanes over C-21. It was thought that the changes in concentration were due to bacterial degradation. (HLW)

26433 (LSU-SG—73-01, pp 265-273) **Some acute effects of low-boiling petroleum fractions on the cellular structures of fish gills under field conditions.** Blanton, W.G.; Robinson, M.C. (Texas Wesleyan Coll., Fort Worth). 1973.

In Microbial degradation of oil pollutants.

The gills of fish were studied as indices of the effects of external irritants and toxins on fish populations in the field. Representative specimens from seven species of fish were randomly selected from areas off the Louisiana coast and from Aransas Bay, Texas, and gills were prepared for microscopic study. Fish taken from the area of the oil slick showed gill damage in the form of cell loss. Physiological malfunctions resulting from cell loss are discussed. (HLW)

26434 (PB—241289) **Implementation plan review for Hawaii as required by the Energy Supply and Environmental Coordination Act. Final report.** (TRW/Environmental Services, Vienna, Va. (USA)). Dec 1974. Contract EPA-68-02-1385. 42p. NTIS $3.75.

Prepared in cooperation with Environmental Protection Agency, San Francisco, Calif. Region IX.

Section 4 of the Energy Supply and Environmental Coordination Act of 1974, (ESECA) requires EPA to review each State Implementation Plan (SIP) to determine if revisions can be made to control regulations for stationary fuel combustion sources without interfering with the attainment and maintenance of the national ambient air quality standards. This document, which is also required by Section 4 of ESECA, is EPA's report to the State indicating where regulations might be revised. (GRA)

26435 (PB—241290) **Implementation plan review for American Samoa as required by the Energy Supply and Environmental Coordination Act. Final report.** (TRW/Environmental Services, Vienna, Va. (USA)). Dec 1974. Contract EPA-68-02-1385. 29p. NTIS $3.75.

Prepared in cooperation with Environmental Protection Agency, San Francisco, Calif. Region IX.

Section 4 of the Energy Supply and Environmental Coordination Act of 1974, (ESECA) requires EPA to review each State Implementation Plan (SIP) to determine if revisions can be made to control regulations for stationary fuel combustion sources without interfering with the attainment and maintenance of the national ambient air quality standards. This document, which is also required by Section 4 of ESECA, is EPA's report to the State indicating where regulations might be revised. (GRA)

26436 (PB—241355) **Oxidants in the urban atmosphere. Final report.** Quon, J.E.; Wadden, R.A. (Illinois Inst. for Environmental Quality, Chicago (USA)). Jan 1975. 87p. (IIEQ—75-04). NTIS $4.75.

Prepared in cooperation with Illinois Univ. Medical Center, Chicago. School of Public Health, and Northwestern Univ., Evanston, Ill.

The major objectives of this study were to identify the main features of the photochemical formation of oxidants, to develop an understanding of the transport and dispersion of photochemical reactants and reaction products, and to elucidate the relationships between the different types of emission sources and the formation of oxidants in the air. Measurements of ozone in Illinois at a

number of monitoring stations during the summer of 1974 show that the concentrations exceeded the ambient air quality standard for oxidants on a number of occasions. The daily peak hour is in general high for high air temperatures and low wind speeds, although the relationship is not well defined. (GRA)

26437 (PB—241400) **Semiannual awards listing grants assistance programs of EPA, 1st half FY '75. Volume II. State and local assistance awards.** (Environmental Protection Agency, Washington, D.C. (USA). Grants Administration Div.). 7 Apr 1975. 183p. (EPA/GAD—1-75-002). NTIS $7.00.

The publication lists all the First half of Fiscal Year 1975 by the United States Environmental Protection Agency in State and Local Assistance Awards. The format of the publication is to have the intital sort by states, then by the various grant programs, then awards to grantees in the State. Each entry consists of the identification of the grantee, the program area-for example water or air, the project title, grant number, award date, and dollar amount. (GRA)

26438 (PB—241476) **Semiannual awards listing grants assistance programs. Volume I. Listing awards during the 1st half of 1975 except state and local assistance awards.** (Environmental Protection Agency, Washington, D.C. (USA). Grants Administration Div.). 15 Apr 1975. 51p. (EPA/GAD—1-75-001). NTIS $4.25.

See also PB—241400.

The publication lists all the First Half of of Fiscal Year 1975 Awards by the United States Environmental Protection Agency except State and Local Assistance. The format of the publication is to have the initial sort by States, then by the various grant programs then awards to grantees in the State. Each entry consists of the identification of the grantee, the program area - for example water of air, the project title, grant number, award date, and dollar amount. (GRA)

26439 (PB—241479) **Financial incentives and pollution control: a case study. Socioeconomic environmental studies series.** Ferrar, T.A.; Brownstein, A.B.; Simpson, J.D.; Streiter, S. (Pennsylvania State Univ., University Park (USA). Center for the Study of Environmental Policy). Apr 1975. Contract EPA-68-01-2250. 58p. NTIS $4.25.

Confronted with shortages of low-sulfur content residual fuel oil, several air-pollution-control authorities in the northeastern states were forced to relax air-quality standards during the winters of 1972-73 and 1973-74. the authorities did so by granting variances to their sulfur-content standards for residual fuel oil. The characteristics of these variances provide the social test-tube for this analysis. The report examines alternative policies such as direct regulation, fuel-oil surcharges, emission taxes and quantity control. (GRA)

26440 (PB—241621) **Implementation plan review for Idaho required by the Energy Supply and Environmental Coordination Act.** (TRW/Environmental Services, Vienna, Va. (USA)). Mar 1975. Contract EPA-68-02-1385. 62p. NTIS $4.25.

Section 4 of the Energy Supply and Environmental Coordination Act of 1974, (ESECA) requires EPA to review each State Implementation Plan (SIP) to determine if revisions can be made to control regulations for stationary fuel combustion sources without interfering with the attainment and maintenance of the national ambient air quality standards. This document, which is also required by Section 4 of ESECA, is EPA's report to the State indicating where regulations might be revised. (GRA)

26441 (PB—241622) **Implementation plan review for Oregon required by the Energy Supply and Environmental Coordination Act.** (TRW/Environmental Services, Vienna, Va. (USA)). Mar 1975. Contract EPA-68-02-1385. 78p. NTIS $4.75.

Section 4 of the Energy Supply and Environmental Coordination Act of 1974, (ESECA) requires EPA to review each State Implementation Plan (SIP) to determine if revisions can be made to control regulations for stationary fuel combustion sources without interfering with the attainment and maintenance of the national ambient air quality standards. This document, which is also required by Section 4 of ESECA, is EPA's report to the State indicating where regulations might be revised. (GRA)

26442 (PB—241623) **Implementation plan review for Maryland as required by the Energy Supply and Environmental Coordination Act. Final report.** (TRW/Environmental Services, Vienna, Va. (USA)). Feb 1975. Contract EPA-68-02-1385. 49p. NTIS $3.75.

Section 4 of the Energy Supply and Environmental Coordination Act of 1974, (ESECA) requires EPA to review each State Implementation Plan (SIP) to determine if revisions can be made to control regulations for stationary fuel combustion sources without interfering with the attainment and maintenance of the national ambient air quality standards. This document, which is also required by Section 4 of ESECA, is EPA's report to the State indicating where regulations might be revised. (GRA)

26443 (PB—241624) **Implementation plan review for Louisiana required by the Energy Supply and Environmental Coordination Act.** (TRW/Environmental Services, Vienna, Va. (USA)). Feb 1975. Contract EPA-68-02-1385. 55p. NTIS $4.25.

Section 4 of the Energy Supply and Environmental Coordination Act of 1974, (ESECA) requires EPA to review each State Implementation Plan (SIP) to determine if revisions can be made to control regulations for stationary fuel combustion sources without interfering with the attainment and maintenance of the national ambient air quality standards. This document, which is also required by Section 4 of ESECA, is EPA's report to the State indicating where regulations might be revised. (GRA)

26444 (PB—241625) **Implementation plan review for North Carolina required by the Energy Supply and Environmental Coordination Act.** (TRW/Environmental Services, Vienna, Va. (USA)). Mar 1975. 21p. NTIS $3.25.

Section 4 of the Energy Supply and Environmental Coordination Act of 1974, (ESECA) requires EPA to review each State Implementation Plan (SIP) to determine if revisions can be made to control regulations for stationary fuel combustion sources without interfering with the attainment and maintenance of the national ambient air quality standards. This document, which is also required by Section 4 of ESECA, is EPA's report to the State indicating where regulations might be revised. (GRA)

26445 (PB—241626) **Implementation plan review for District of Columbia as required by the Energy Supply and Environmental Coordination Act. Final report.** (TRW/Environmental Services, Vienna, Va. (USA)). Mar 1975. Contract EPA-68-02-1385. 32p. NTIS $3.75.

Section 4 of the Energy Supply and Environmental Coordination Act of 1974, (ESECA) requires EPA to review each State Implementation Plan (SIP) to determine if revisions can be made to control regulations for stationary fuel combustion sources without interfering with the attainment and maintenance of the national ambient air quality standards. This document, which is also required by Section 4 of ESECA, is EPA's report to the State indicating where regulations might be revised. (GRA)

26446 (PB—241757) **Directory of EPA, state, and local environmental quality monitoring and assessment activities. Final report.** Scotton, J.W.; Mullen, K.T.; Whitman, J.; Citron, R. (Smithsonian Institution, Cambridge, Mass. (USA). Center for Short-Lived Phenomena). Dec 1974. Contract EPA-68-01-2442. 385p. NTIS $10.25.

The directory describes state and local environmental quality monitoring programs of the United States. It also includes the Environmental Protection Agency's (EPA) national programs and systems which collect, analyze and evaluate these data. It will be useful as a reference and a guide to more detailed information. (GRA)

26447 (PB—241807) **Air quality data: 1973 fourth quarter statistics. Quarterly report, Oct—Dec 1973.** (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Office of Air Quality Planning and Standards). Nov 1974. 124p. (EPA—450/2-74-014). NTIS $5.25.

See also PB—237599.

This report is a statistical summary report on ambient air quality submitted to EPA from air monitoring operations of state, local and federal networks. (GRA)

26448 (PB—241808) **Air quality data: 1973 annual statistics. Annual report, 1973.** (Environmental Protection Agency, Research Triangle Park, N.C. (USA). Office of Air Quality Planning and Standards). Nov 1974. 145p. (EPA—450/2-74-015). NTIS $5.75.

See also PB—232588.

This report is a statistical summary report on ambient air quality submitted to EPA from air monitoring operations of state, local and federal networks. (GRA)

26449 (UCRL—52000-76-4, pp 18-23) **Environment, health and safety. Abestos monitoring: new techniques studied.** Apr 1976.

In Energy and technology review.

Of the various techniques investigated, x-ray diffraction appears to offer not only a specific and reasonably consistent method for assessing the quantity of chrysotile asbestos in an air sample, but one that is also suitable for automation. The feasibility of an x-ray-based monitoring technique, however, will depend on (1) the acceptance of a mass density rather than number density criterion for asbestos standards, and (2) knowledge of the particle-size distribution in each sampling area. In routine applications, a periodic

cross calibration with optical particle counting should be considered acceptable assurance that the x-ray method is providing adequate monitoring.

26450 Study of SO_2 adsorption on a stepped platinum single crystal surface by photoelectron spectroscopy. Siekhaus, W.; Novakov, T. Contract W-7405-ENG-48. Berkeley, CA; Univ. of California (1973). 6p.

Sulfur dioxide was adsorbed at room temperature, under UHV conditions on a stepped single crystal surface of platinum, and observations were made with X-ray photoelectron spectroscopy. The observed energies and intensities of oxygen, sulfur, and platinum photoelectron lines showed the SO_2 to decompose at the Pt surface to form a surface sulfide. The sulfur is chemisorbed on the surface via electron transfer from Pt to S. Only a small fraction of that oxygen stays on the surface, probably in the molecular form. The O_2 fragment leaves the surface in about 75 percent of the SO_2 adsorption events leading to the sulfide formation.

26451 Prospective surveys of acute respiratory disease in volunteer families: 1970—1971 New York studies. Love, G.J.; Cohen, A.A.; Finklea, J.F.; French, J.G.; Lowrimore, G.R.; Nelson, W.C.; Ramsey, P.B. pp 5.49-5.69 of In Health consequences of sulfur oxides. Report from CHESS, 1970—1971. Research Triangle Park, NC; Environmental Protection Agency (1974).

A prospective survey of over 3000 volunteers from families living in three communities with differing air pollution exposures in New York City and Suffolk County attributed significant increases in the frequency and severity of acute lower respiratory illness to ambient air pollutants. Exposures of 2 to 3 years involving 256 to 321 micrograms/cu m of sulfur dioxide accompanied by 97 to 123 micrograms/cu m of total suspended particulates and 10 to 15 micrograms/cu m of suspended sulfates were linked to excessive illnesses with the effects of suspended nitrates also noted. There was suggestive evidence that control of air pollution substantially decreases susceptibility to acute lower respiratory illness. The average family of four might expect to experience 5 extra days of restricted activity and one extra physician visit each year as a result of the excess acute lower respiratory disease morbidity. Illness frequency increased with increasing socio-economic status, recent family migration, cigarette smoking in the home, and parental history of chronic bronchitis.

26452 Present status and problems of the methods of measurement of nitrogen oxides. Sakata, M. *PPM;* **5**: No. 10, 2-11(Oct 1974). (In Japanese).

Measurement of environmental nitrogen oxides concentration and that of NOx at the site of appearance of NOx are separately discussed because the concentration of the former is on the level of 0.1 to 0.2 ppM, whereas that of the latter is at the level of 1000 ppM. The former measurement is made either by chemical methods or by automatic or physical methods. Of the chemical methods, the naphthyl ethylenediamine method and the Saltzman method are the most popular. Most popular automatic methods of analysis are absorption spectroscopy and the chemical emission method. For the determination of the NOx concentration at the site of appearance, chemical methods such as the PDS method, the nitrate ion-electrode method, the zinc reduction NEDA method, and the continuous methods such as the chemical emission method, infrared absorption, ultraviolet absorption, the potentiostatic coulometric method, and the potentiostatic electrolysis method are used. At present, the reliability of various methods for the quantitative determination of NOx is doubtful. The American Environmental Protection Agency suggests that the effect of oxidants cannot be ignored at NOx concentrations below 0.1 ppM, when a continuous analyzer of the Saltzman type is used.

26453 (ORNL-tr—4114) **Contamination of food with carcinogenic hydrocarbons of environmental origin.** Engst, R.; Fritz, W. Translated from *Rocz. Panstw. Zakl. Hig.;* **26**: No. 1, 113-118(1975). 8p. Dep. NTIS $3.50.

Cancerogenic hydrocarbons in food are not only the result of technological processes as heating, roasting, or smoking, they are also a problem of environment pollution. In order to establish the extent and the sources of environment pollution of foodstuffs by cancerogenic polyaromatic hydrocarbons vegetables, fruits, and pertinent soil samples were investigated. The degree of contamination is approximately parallel with the degree of contamination in the soil; its content of polyaromatic hydrocarbons increases conspicuously with a growing density of traffic and especially in dependence of industrial emitters. In areas with little traffic and industry the 3,4-benzpyrene content amounts to 5 to 700 μg/kg and is relatively low. It increases up to 3000 μg/kg near main roads and in unfavourable cases near industrial emitters it even reaches much higher values. With 650,000 μg 3,4-benzpyrene/kg soil on the terrain of a soot factory near the heating house, the degree of contamination is happening but once on an international scale. In lettuce maximum values of 150 μ/kg dry weight of 3,4-benzpyrene were found. The possibilities of reducing the unwanted polyaromatics and of decontamination are discussed. (auth)

26454 Determination of airborne particle size distributions: calculation of cross-sensitivity and discreteness effects in cascade impaction. Natusch, D.F.S.; Wallace, J.R. (Univ. of Illinois, Urbana). *Atmos. Environ.;* **10**: No. 4, 315-324(1976).

A theory is developed which permits numerical evaluation of errors associated with the determination of aerosol size distributions using cascade impactors. Account is taken of errors due to the overlap of a given particle size between adjacent impaction stages and to the discrete nature of cascade impaction. The theory is applied to both log-normal and polynomial functional approximations to an aerosol size distribution. Numerical determination of errors considered shows that the mass of large and small particles present in the wings of a log-normal aerosol distribution is overestimated manyfold by most cascade impactors but that the mass of particles having aerodynamic diameters close to the aerosol mass median diameter is generally subject to quite small (less than 20%) negative errors. Even under extremely unfavorable conditions the mass median diameter of an aerosol can be determined to well within 25% of the true value.

26455 Measurements of atmospheric pollutants in the St. Louis area. Breeding, R.J.; Klonis, H.B.; Lodge, J.P. Jr.; Pate, J.B.; Sheesley, D.C.; Englert, T.R.; Sears, D.R. (National Center for Atmospheric Research, Boulder, CO). *Atmos. Environ.;* **10**: No. 3, 181-194(1976).

Measurements of the concentrations of trace gases and particles have been made in the plume from metropolitan St. Louis at 80 and 120 km from the urban center. The concentrations of SO_2, NO_2, NO, NH_3, H_2S, aldehydes, CO, total hydrocarbons, and $CFCl_3$ were determined. The concentrations of many of these gases were found to be significantly higher in the plume than outside the plume at these distances. Measurements were made near the ground and from an aircraft. The width of the plume was usually between 20 and 30°, which is less than had been expected. By comparing the concentrations measured at 80 km from the city with those measured at 120 km from the city, and using the decrease of conservative trace gases to account for loss through physical process, we have arrived at preliminary estimates of the decay rates for a few trace gases. The evidence is most compelling for sulfur dioxide, and it appears that, at ca. 100 km from the city, the overall half-life of SO_2 is between 2 and 8 h.

26456 Color of the Los Angeles smog. Husar, R.B. (Washington Univ., St. Louis); White, W.H. *Atmos. Environ.;* **10**: No. 3, 199-204(1976).

The origin of the yellow brown coloration of the Los Angeles smog layer was investigated theoretically by solving the radiation transfer equation for an optically thin (in vertical direction) scattering and absorbing haze layer. Using the available data on NO_2 absorption and smog aerosol size spectra, it was found that in addition to the NO_2 absorption and aerosol scattering, the angle between the observer's line of sight and the sun plays an important role in the coloration of the smog layer and it also determines the relative importance of NO_2 and aerosol.

26457 Particle bounce errors in cascade impactors. Dzubay, T.G.; Hines, L.E.; Stevens, R.K. (Environmental Protection Agency, Research Triangle Park, NC). *Atmos. Environ.;* **10**: No. 3, 229-234(1976).

In a series of field measurements on atmospheric aerosols using cascade impactors, it was found that the nature of the impaction surface has a significant effect on the apparent size distribution. For each measurement, two identical cascade impactors were operated simultaneously. Dry impaction surfaces were used in the first and, as a reference, grease-coated foils were used in the second. The types of dry impaction surfaces which were tested include aluminum foil, glass fiber filter material and wax-coated paper. From a comparison of the measured size distributions, it can be concluded that the use of dry impaction surfaces leads to a distorted measurement of the size distribution. The distortion is attributed to particles bouncing off of the dry impaction surfaces and being collected on subsequent stages or on the backup filter.

26458 Photochemical particulate formation in sulfur dioxide: air mixtures. Shen, C.H.; Springer, G.S. (Univ. of Michigan, Ann Arbor). *Atmos. Environ.;* **10**: No. 3, 235-239(1976).

Experiments were performed studying the formation of particulates in sulfur dioxide air mixtures irradiated by ultraviolet light. Measurements were made for five different initial sulfur dioxide concentrations (0.2, 0.3, 0.5, 0.7 and 1 ppM) and for four relative humidities (25, 50, 75 and 100%). The data show that the maximum number of nuclei (particles smaller than 0.1 μm) produced in the mixture is proportional to the initial sulfur dioxide

concentration and to the square of the relative humidity. Particles larger than 0.3 μm were not present in measurable amounts in the mixture.

26459 Energy absorption by volatile atmospheric aerosol particles. Baker, M.B. (Univ. of Washington, Seattle). *Atmos. Environ.*; **10**: No. 3, 241-248(1976).

Absorption of both ir and visible radiation by atmospheric aerosol particles may be important in heating or cooling of the atmosphere. The variations in properties of both particles and their surroundings due to this energy absorption depend on the volatility of the particle material. Care must be taken in designing measurements of particle absorption efficiencies to take into account possible evaporation of the particles and its effect on the parameters being measured. The role of evaporation in modifying the properties of particles and surrounding medium is calculated for time independent and time dependent energy sources. It is shown that under certain conditions acoustical techniques may be useful in studying aerosol absorption.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 25460, 26431, 26446

26460 (AD-A—010264) **Pilot installation of automatic radiological monitoring systems. Final report.** Johnson, R.S. (Gautney and Jones Communications, Inc., Falls Church, Va. (USA)). Aug 1974. Contract OCD-PS-66-116. 193p. (G/J-TR—66.116-74.01). NTIS $7.00.

The study describes adaptation of existing automatic air quality data acquisition and telemetry networks to include radiological monitoring. Two ranges of radiological equipment .1 R/hr - 10,000 R/hr (high range); and ambient background of up to 500 counts per minute (low range) were added on a single telemetry channel to air quality telemetry systems in New York City, Chicago, and the State of Delaware. Specialized interface equipment was designed and is described. A technique for digitally compressing five decades of radiological instrument dynamic range on a telemetry system capable of only three decades of range was developed. Data transmission links from the air monitoring network control station to Civil Defense emergency operating centers (EOC) were engineered and installed in New York City and Delaware. Use of a representative leased wire-line siren control system for combined siren control and radiological telemetry was investigated but not implemented because of tariff restrictions on the leased lines. Results indicated that use of air quality telemetry systems for radiological monitoring is technically and operationally feasible. (GRA)

26461 (BNWL-B—477) **Environmental status of the Hanford site for CY-1975.** Fix, J.J.; Speer, D.R.; Blumer, P.J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1976. Contract E(45-1)-1830. 72p. Dep. NTIS $4.50.

Environmental data collected during 1975 showed continued compliance of Hanford operations with applicable State and Federal regulations regarding ambient pollutant levels in the environs. Levels of radioactivity in the atmosphere measured at 21 onsite stations, 17 perimeter stations and 5 distant stations showed no conclusive observable effect from Hanford operations. Levels of radioiodine, tritiated water vapor, ^{90}Sr, plutonium, and gamma-emitting radionuclides were measured during the year. No apparent differences between levels measured at onsite, perimeter, and distant stations were detected. All analyses of sanitary water obtained from the Columbia River at 100-N, 300 Area, and Richland water plant were less-than detectable with the exception of gross alpha, gross beta, ^{90}Sr, and on one occasion ^{137}Cs. Tritium was measured in river water at Vernita Bridge and Richland. There was no indication that Hanford operations contributed to the observed concentrations. Radiological analyses of drinking water at FFTF and WPPSS operations showed elevated levels of ^{3}H present due to seepage in the groundwater from the 200 Areas. A person who consumes 1.1 liters of water per working day containing 50,000 pCi/l of ^{3}H and works 5 days per week, 50 weeks per year will incur an annual dose of approximately 1.6 mrem. Observable influx of radioactivity into the Columbia River from riverbank springs at 100-N and of NO_3, F, and U from riverbank springs at the 300 Area was apparent. These pollutants were diluted in the river to essentially background levels within a short distance from entry into the river. Watercress collected from the 100-N springs showed elevated levels of several radionuclides.

26462 (BNWL-SA—5778) **Release of tritium from fuel and collection for storage.** Burger, L.L.; Trevorrow, L.E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); Argonne National Lab., Ill. (USA)). Apr 1976. Contract E(45-1)-1830. 60p. (CONF-760806—3). Dep. NTIS $4.50.

From Meeting on controlling airborne effluents from fuel cycle plants; Sun Valley, Idaho, United States of America (USA) (5 Aug 1976).

Recent work is reviewed on the technology that has been suggested as applicable to collection and storage of tritium in anticipation of the necessity of that course of action. Collection technology and procedures must be adapted to the tritium-bearing effluent and to the facility from which it emerges. Therefore, this discussion of tritium collection technology includes some information on the processes from which release is expected to occur, the amounts, the nature of the effluent media, and the form in which tritium appears. Recent work on collection and storage concepts has explored, both by experimentation and by feasibility analyses, the operations generally aimed at producing recycle, collection, or storage of tritium from these streams. Storage concepts aimed specifically at tritium involve plans to store volumes ranging from that of the entire effluent stream to only that of a small volume of a concentrate. Decisions between storage of unconcentrated streams and storage of concentrates are expected to be made largely by weighing the cost of storage space against the cost of concentration. The storage of tritium concentrate requires the selection of a form of tritium possessing physical and chemical properties appropriate for the expected storage conditions. This selection of an appropriate storage form has occupied a major portion of recent work concerned with tritium storage concepts. In summary, within the context of present regulations and expected amounts of waste tritium; this waste can be disposed of by dilution and dispersal to the environment. In the future, however, more restrictive regulations might be introduced that could be satisfied only by some collection and storage operations. Technology for this practice is not now available, and the present discussion reviews recent activities devoted to its development.

26463 (CONF-760806—4) **Airborne effluent control at uranium mills.** Sears, M.B. (Oak Ridge National Lab., Tenn. (USA)). 1976. 14p. Dep. NTIS $4.00.

From Meeting on controlling airborne effluents from fuel cycle plants; Sun Valley, Idaho, United States of America (USA) (5 Aug 1976).

The Oak Ridge National Laboratory has made an engineering cost—environmental benefit study of radioactive waste treatment systems for decreasing the amount of radioactive materials released from uranium ore processing mills. This paper summarizes the results of the study which pertain to the control and/or abatement of airborne radioactive materials from the mill processes. The tailings area is not included. Present practices in the uranium milling industry, with particular emphasis on effluent control and waste management, have been surveyed. A questionnaire was distributed to each active mill in the United States. Replies were received from about 75 percent of the mill operators. Visits were made to six operating uranium mills that were selected because they represented the different processes in use today and the newest, most modern in mill designs. Discussions were held with members of the Region IV Office of NRC and the Grand Junction Office of ERDA. Nuclear Science Abstracts, as well as other sources, were searched for literature pertinent to uranium mill processes, effluent control, and waste management.

26464 (DPST—65-302) **Environmental monitoring at the Savannah River Plant. Annual report, 1964.** Ashley, C. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 15 Jun 1965. Contract AT(07-2)-1. 36p. Dep. NTIS $4.00.

This is the second in a series of annual reports summarizing the results obtained from the environmental monitoring program at the Savannah River Plant (SRP). D ata are included on SRP releases of radioactive materials and their dispersion in the environment during 1964. (CH)

26465 (LURI—1974-02) **Gamma radiation and contamination of persons in the surrounding of a nuclear power station: a research program.** Liden, K. (Lund Univ. (Sweden). Radiofysiska Institutionen). Jun 1974. 11p. (In Swedish). (CONF-740671—2). INIS.

From Meeting of Nordic Society for radiation protection; Helsinki, Finland (5 Jun 1974).

A project for environment control in the surrounding of a nuclear power station is described. The project includes gammaspectrometric field studies of natural and artificial radionuclides in the ground and in the air, studies of contamination of people in the surroundings of nuclear power stations, and a few food chains. The Swedish nuclear power station Barsebaeck is choosen as an example. The apparatus for the gammaspectrometric field measurements is described. For the activity measurements a whole-body counter is used. It is concluded that environment control of this kind is important because it can be carried out independently of the administration of the nuclear power plant.

26466 (TID—27030) **Environmental monitoring report, 1975.** (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 20 Apr 1976. 35p. Dep. NTIS $4.00.

The Pinellas Plant is operated for the U. S. Energy Research and Development Administration (ERDA) by the Neutron Devices Department of the General Electric Company. The plant's 1100 employees are engaged in the design, development, and manufacture of special electronic and mechanical nuclear weapons components. The effluent and environmental monitoring programs maintained by the Pinellas Plant are designed to determine the efficiencies of treatment and control mechanisms, to provide measurements of discharge concentrations for comparison with applicable standards, and to assess the effect of these discharges on the environment. Small quantities of tritium gas, tritium oxide, and krypton-85 gas were released from the plant during the year. Average ground level concentrations of these radioisotopes were all significantly less than 1/10 of 1 percent of the recommended guide for continuous nonoccupational exposure. (CH)

26467 **Measurements of stratospheric residence times.** Reiter, E.R.; Carnuth, W.; Kanter, H.J.; Poetzl, K.; Reiter, R.; Sladkovic, R. (Colorado State Univ., Fort Collins). *Arch. Meteorol., Geophys. Bioklimatol., Ser. A;* **24**: 41-51(1975).

Measurements of the $^{32}P/^{7}Be$ ratios conducted on Zugspitze Mountain in Germany can be used to establish residence times of airmasses in the lower stratosphere. There appears to be a seasonal trend to such residence times, yielding a median value of greater than 36 days during spring and greater than or equal to 17 days during fall.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

26468 (ORNL-tr—4101) **Use of a powered glider equipped with instruments for three-dimensional structural study of man-made thermal convection.** Fortak, H. 1975. Translated by R.G. Mansfield from German. 57p. Dep. NTIS $4.50.

The use of an aircraft for making meteorological measurements in order to solve a special problem of the man-made burden in the atmosphere is described. The object of the studies was to determine the three-dimensional dynamic and thermal structure of cooling tower convection streams. From the results of many transverse flights over cross sectional surfaces of the streams, it was shown that in proximity to the cooling tower (up to a distance of 2 or 3 km) the currents behave very similarly to a turbulent free jet. The structure of the stream has the peculiarity that, in its upper part, sudden changes in moisture predominate, while at the lower levels the abrupt temperature changes appear to have greater significance. The stream is not limited to the visible part but, owing to the measured abrupt changes in moisture and temperature, is also detectable below this. The necessity of an aerological fine probing for assessing the structure of the stream. The possibility of breakthrough of inversions was studied systematically, and it was shown that the determining factor in this is the vertical circulation produced by the stream. (auth)

26469 **Time-varying energy consumption as a factor in urban climate.** Torrance, K.E.; Shum, J.S.W. (Cornell Univ., Ithaca, NY). *Atmos. Environ.;* **10**: No. 4, 329-337(1976).

The thermal effects of urban energy consumption are investigated using a time-dependent, one-dimensional, numerical model. The surface energy balance includes a time-varying rate of anthropogenic heat addition from transportation, electric consumption, and space heating sources. Industrial input is treated as a constant. The contribution of each source to the urban temperature is determined for typical winter and typical summer days. Results indicate that transportation and electric usage accentuate the afternoon heat island and moderate the nocturnal heat island. Space heating in winter enhances the nocturnal heat island. Comparison of urban and rural simulations reveals two distinct types of urban heat islands, controlled by the combined effects of heat addition, moisture, and roughness. The moderating influence of increasing wind speed is also examined.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 25919, 25977

ENVIRONMENTAL SCIENCES, TERRESTRIAL

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 26186, 26437, 26438, 26446, 26453, 26489

26470 (LSU-SG—73-01, pp 153-161) **Bacterial degradation of mineral oils at low temperatures.** ZoBell, C.E. (Scripps Institution of Oceanography, La Jolla, CA). 1973.

In Microbial degradation of oil pollutants.

Psychrophilic oil-oxidizing bacteria were demonstrated in 13 samples of oil-polluted water, soil, and tundra muck collected from the North Alaska Slope. Within a week or two there was visual evidence that clear mineral oil was being degraded by bacteria at 8 and 4 C. Such activity became apparent after two to three weeks' incubation at -1.1°C, the freezing point of the medium. From oxygen uptake data it was calculated that bacteria oxidized mineral oil at rates ranging from 0.13 to 0.9 mg/liter/day at -1.1°C. Assuming an average generation time of 24 hours, it is calculated that a bacterial population of 10^8 reproducing cells per ml of mineral oil medium would consume oil for building biomass at a rate of 1.2 mg/liter/day at -1.1°C. Nine different crude oils were found to be slowly attacked by bacteria growing at -1.1°C.

26471 **Impact of molybdenum-enriched irrigation water on agricultural soils near Brighton, Colorado.** Jackson, D.R. (Oak Ridge National Lab., TN); Lindsay, W.L.; Heil, R.D. *J. Environ. Qual.;* **4**: No. 2, 223-229(1975).

The Mo concentration in water, soils, and alfalfa (Medicago sativa) was monitored for 1 growing season. The concentration of Mo in irrigation water in this area ranged from 27 to 213 ppB. A significant increase of Mo concentration in alfalfa and available soil Mo was observed at 1 site irrigated with water containing 213 ppB Mo, and the Mo concentration in the alfalfa increased during the growing season from 4.3 to 7.2 ppM which is below the 10 ppM level considered toxic to livestock. Plant Mo was highly correlated ($r = 0.94$) with resin-extractable Mo in a greenhouse experiment using soils from 3 of the field sites. Field results were less satisfactory ($r = 0.51$), partially due to limited indigenous levels of Mo in the soils. A simulation model was used to assess the potential hazards of irrigating with water containing from 0 to 600 ppB Mo. The model indicates that a level of 400 ppB Mo in irrigation water applied to soil with 40 percent retention of Mo in an available form would result in toxic levels of Mo in plants within 3 yr. The impact of Mo on the Brighton area during 1 growing season was minimal in relation to uptake of Mo by plants.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 26446, 26461, 26464, 26649

26472 (BNWL—1983) **Review of actinide-sediment reactions with an annotated bibliography.** Ames, L.L.; Rai, D.; Serne, R.J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 10 Feb 1976. Contract E(45-1)-1830. 527p. Dep. NTIS $10.00.

The annotated bibliography is divided into sections on chemistry and geochemistry, migration and accumulation, cultural distributions, natural distributions, and bibliographies and annual reviews. (LK)

26473 (CONF-760709—1) **Comparison of mass transport using average and transient rainfall boundary conditions.** Duguid, J.O.; Reeves, M. (Oak Ridge National Lab., Tenn. (USA)). 1976. 12p. Dep. NTIS $3.50.

From Proceedings of international symposium on finite elements in water resources; Princeton, New Jersey, United States of America (USA) (12 Jul 1976).

A general two-dimensional model for simulation of saturated-unsaturated transport of radionuclides in ground water has been developed and is currently being tested. The model is being applied to study the transport of radionuclides from a waste-disposal site where field investigations are currently under way to obtain the necessary model parameters. A comparison of the amount of tritium transported is made using both average and transient rainfall boundary conditions. The simulations indicate that there is no substantial difference in the transport for the two conditions tested. However, the values of dispersivity used in the unsaturated zone caused more transport above the water table

than has been observed under actual conditions. This deficiency should be corrected and further comparisons should be made before average rainfall boundary conditions are used for long-term transport simulations.

26474 (LA-UR—76-1335) **Soils element history, sampling, analyses, and recommendations.** Fowler, E.B.; Essington, E.H. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 32p. (CONF-760210—3). Dep. NTIS $4.00.

From Nevada applied ecology group plutonium and other transuranics information conference; Las Vegas, Nevada, United States of America (USA) (12 Feb 1976).

A five year history of the Soils Element of the Nevada Applied Ecology Group (NAEG) is presented. Major projects are reviewed. Emphasis is placed on mound studies and profile studies for the period March 1, 1975, through February 1, 1976. A series of recommendations is made relative to extensions of past efforts of the Soils Element of the NAEG.

SOIL

REFER ALSO TO CITATION(S) 25467, 26179, 26184, 26471

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 26453, 26465

26475 (PB—245598) **Preliminary milk report. Environmental monitoring series.** Jarvis, A.N.; Easterly, D.G. (National Environmental Research Center, Las Vegas, Nev. (USA)). Jun 1975. 43p. (EPA—680/4-75/007). NTIS $3.75.

A summary of the results of the milk cross-check program from July 1973 through November 1974 is given. Examination of these results reveals that 29% of the participants were within the plus or minus 3 sigma control limits for strontium-89 analysis, 42% for the strontium-90, 52% for barium-140, 60% for iodine-131, and 77% for cesium-137. These results indicate the need for improvement in analytical procedures for the radionuclides studies. Accurate analysis of strontium-89 was particularly difficult for most laboratories to achieve, while the accurate analysis of cesium-137 was the least difficult. (GRA)

26476 (PRNC—193) **Potentially hazardous plants of Puerto Rico: preliminary guide.** Ferguson, F.F.; Medina, F.R. (Puerto Rico Nuclear Center, Mayaguez). Aug 1975. Contract E(40-1)-1833. 52p. (In Spanish and English). Dep. NTIS $4.50.

General information is presented about the kinds of native and imported plants in Puerto Rico (weeds, grasses, vines, cactuses, shrubs, trees and parts thereof) that should be avoided, or not ingested. Small amounts of eaten wild plant materials are usually not likely to be hazardous although large amounts may be dangerous; the striking exception is mushrooms. While a number of Puerto Rican plants are lethal to cattle, only a few are known to cause death to man as, for example, the fruit of the Deadly Manchineel, Hippomane mancinella and the seed of the Rosary Pea, Abrus precatorius. Tourists especially should avoid tasting any green or yellowish apples growing on a medium-sized tree. The Hippomane fruit resembles the Crabapple of temperate zones. It is now unlawful to use the Rosary Pea in the local handicraft industry. An item of special interest is the delicious fruit of Mamey often offered for sale at roadside, the outer coating of which is poisonous. All of the light brown outer covering, including especially all of the inner whitish tunic, must be carefully removed from the golden yellow fruit before eating, or else illness may result. Relatively few of the plants presented here will produce major physical problems if only contacted or chewed, but ingestion of some plant parts produces severe toxic symptoms.

26477 **Iodine-129 in thyroids of grazing animals.** Ballad, R.V.; Holman, D.W.; Hennecke, E.W.; Johnson, J.E.; Manuel, O.K.; Nicholson, L.M. (Missouri Univ., Rolla (USA)). *Health Phys.*; **30**: No. 4, 345-350(Apr 1976).

A combination of neutron activation and mass spectrometry has been used to determine the concentrations of fissiogenic ^{129}I and stable ^{127}I in thyroids of grazing animals and in mineral iodine. The $^{129}I/^{127}I$ ratios are lowest in mineral iodine and in a given area lower in cow thyroids than in deer thyroids. Near saturation levels of mineral iodine in commercial feeds and salt licks may account for differences in the ^{129}I levels of cows and deer. Values of the $^{129}I/^{127}I$ ratio in deer appear to vary inversely with the iodine concentration of the thyroid.

26478 **General population exposure of stable lead and ^{210}Pb to residents of New York City.** Bogen, D.C.; Welford, G.A.; Morse, R.S. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). *Health Phys.*; **30**: No. 4, 359-362(Apr 1976).

Brief note.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 25287, 25919, 25921, 25940, 25954, 25956, 25977, 25995, 26522

26479 **Nitrification of a high ammonia content sludge supernatant by use of rotating discs.** Lue-Hing, C.; Obayashi, A.W.; Zenz, D.R.; Washington, B.; Sawyer, B.M. (Dept. of Research and Development, Chicago). pp 245-254 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

The results of a study conducted to determine whether a population of nitrifiers of sufficient size could be established on the available area of the rotating discs of the fixed-bed reactor to effect the oxidation of a high strength ammonia wastewater at a reasonable detention time showed 99 percent efficiency. In comparison with other studies, oxidation and removal efficiency were much greater with rotating discs. Performance of the rotating discs as aeration-reaeration system was evaluated simultaneously. This study was conducted in connection with land reclamation and sludge recycle programs utilizing strip-mined areas for row crop production and grazing. (PCS)

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 26661

26480 (ANL/WR—76-1) **Water resources research program nearshore currents at Point Beach, Wisconsin (1974—1975).** Saunders, K.D.; Van Loon, L.; Tome, C.; Harrison, W. (Argonne National Lab., Ill. (USA)). Mar 1976. Contract W-31-109-Eng-38. 252p. Dep. NTIS $9.00.

Coastal currents of Lake Michigan were monitored at stations 0.4, 1.1, and 3.8 km from shore along a coast-perpendicular transect located 1 km south of the Wisconsin Electric Power Company's nuclear generating station. Complete specifications are given for current meter calibrations, electronics used, winter and summer mooring configurations, and for the performance of each meter and mooring assembly. Local winds were monitored at the power plant intake using a mechanical, MRI wind system. The following types of graphs are presented for current and wind observations: (1) U, V flow components versus time, (2) specific kinetic energy versus time, (3) flow speeds and directions versus time, (4) composite velocity histograms and associated U, V-component histograms, and (5) progressive vector diagrams. A linear, optimal-filter design technique (Wiener filter) is used to estimate the efficiency of wind-driven, linear, nearshore current-prediction models. The poor predictions of the models probably relate to such factors as lack of input for superimposed lake currents, time-base errors, and wind-stress formulas.

26481 (COO—3390-27) **Accumulation and transport of minerals by marine protozoa. Progress report, September 1, 1975—August 31, 1976.** Gold, K. (New York Aquarium, Brooklyn (USA). Osborn Labs. of Marine Sciences). May 1976. Contract E(11-1)-3390. 9p. Dep. NTIS $3.50.

The agglutinated Tintinnida have the unique ability among ciliates to incorporate particles into their loricae that are in the same size range as silts. The ecological significance of this form of mineral accumulation lies in biological concentration and cycling of radionuclides, metals, or other toxic substances from the sediments or water to the biota. Loricae have been characterized on the basis of the particulate matter accumulated: predominantly non-biogenic origin; predominantly biogenic origin, especially coccoliths; a combination of non-biogenic and biogenic materials, the latter including a variety of materials, e.g., fragments of protozoan shells, coccoliths, and diatom frustules; hyaline or clear mineral-free structures, generally without adhering particles. Electron probe analysis was used to identify the chemical constituents of the principal non-biogenic grains on specimens from the eastern coast

of the U. S. The predominant mineral constituent was silicon, probably in the form of quartz. The particles utilized by a benthic foraminiferan, an amoeba from the same region, were also the same type and in the same size range. In contrast to the accumulation of Si-containing particles, the principal mineral found in the irregularly-shaped grains on specimens from Eniwetok Atoll was calcium probably as calcium carbonate.

26482 (LSU-SG—73-01, pp 127-139) **Distribution and abundance of oil-oxidizing bacteria in the North Sea.** Gunkel, W. (Biologische Anstalt Helgoland, Meeresstation, Ger.). 1973.

In Microbial degradation of oil pollutants.

Studies were conducted on distribution of oil-oxidizing and total heterotrophic bacteria in the waters, surface films, sediments, and black sands of the North Sea in the vicinity of Helgoland and in the River Elbe estuary. Microbial concentrations in unpolluted samples, as great as 10^6 per l of sediment, are reported. Data indicated the presence of a large bacterial population able to decompose different types of hydrocarbons. (HLW)

26483 (UCRL-Trans—11062) **Optimal control of the level of the Caspian Sea.** Podol'skii, E.M. Translated from *Vodn. Resur.*; No. 4, 81-108(1975). 55p. Dep. NTIS $4.50.

The Caspian Sea has long fascinated many researchers, especially after an eight-year drought period caused a drop in its level. This climatic anomaly of the 1930's that caused a drop of more than 2 m, the probability of this phenomenon's recurrence, and the fate of the Caspian Sea in the future are discussed. Under the present conditions ordinary climate fluctuations will be less significant than the effect of the ever-increasing nonreplenished removal of water in its basin. Calculations of the water balance for the Caspian for the period 1970 to 2010, using strongly differing, extreme estimates of inflow, evaporation, and growth of the water demands (scales of irrigation), indicate that under the most probably average conditions of inflow and evaporation by 2010 one can expect a 1.8 to 4.2 m drop in the level of the Sea. This will harm the production and catching of valuable species of fish, sea transportation, and oil production. Providing water for the developing domestic economy and maintaining the level of the Caspian is possible by diverting to its basin portions of the drainage from northern rivers, but the cost is great. An optimal plan is presented for development of the productive forces in the Caspian Basin (including the most water-intensive area, irrigated agriculture), diverting the flow of northern rivers, and determining the level of the Caspian Sea, which depends on the other factors. Only a comparison of all costs and benefits connected with the placement of industry in the Caspian Basin versus other regions (against the background of the total development plan for the domestic economy), with the diversion of northern rivers, and with the change in the Sea's level, will provide a solution which yields optimal benefits to the domestic economy as a whole. (CH)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 25289, 25347, 25348, 25349, 25350, 25351, 25352, 25353, 25354, 25355, 25356, 25357, 25358, 25359, 25360, 25362, 25363, 25541, 26012, 26184, 26186, 26437, 26438, 26446, 26470, 26531, 26582, 26583, 26584, 26585

26484 (CONF-750929—4) **Availability of sediment-bound cobalt, silver, and zinc to a deposit-feeding clam.** Luoma, S.N.; Jenne, E.A. (Geological Survey, Menlo Park, Calif. (USA)). 1975. 34p. Dep. NTIS $4.00.

From 15. symposium on the biological implications of metals in the environment; Richland, Washington, USA (29 Sep 1975).

The availability to Macoma balthica of sediment-bound metals was dependent upon the physical-chemical nature of the metal-sediment association. Laboratory studies of bioaccumulation from individual sedimentary trace-element sinks labelled with radioactive tracers of Ag, Co and Zn indicated bioavailability varied among metals within a given sink and among sinks for a given metal. Little bioaccumulation was observed from several sinks which may be common in nature, e.g., little Zn or Co uptake was observed when those metals were coprecipitated with amorphic iron oxide or manganese oxide. However, Ag, Co, and Zn were all taken up from detrital organics and Ag was accumulated by the clam from the iron oxide precipitate. Even quantitatively minor sinks within aquatic sediments may be important sources of some metals for M. balthica. Uptake rates of Co and Zn from biogenic carbonates (crushed clam shells) were significantly greater than rates of uptake from other sinks. Likewise, Ag uptake from both biogenic carbonates and synthetic calcites was greater than Ag uptake from iron oxides or detrital organics. Sinks from which bioaccumulation of bound metals was greatest also showed the greatest rate of sediment to water desorption of metals. Where such sinks are abundant in nature, bioavailability of sediment-bound metals may be enhanced both through increased uptake from ingested particulates by deposit feeders, and through increased sedimentary desorption, resulting in higher concentrations of solute metals.

26485 (CONF-760461—1) **Preliminary results from a study of coal mining effects on water quality of the Tongue River, Wyoming.** Olsen, R.D.; Dettmann, E.H. (Argonne National Lab., Ill. (USA)). 1976. 11p. Dep. NTIS $3.50.

From 52. annual meeting of the AAAS southwestern and rocky mountain division; Tucson, Arizona, United States of America (USA) (28 Apr 1976).

A preliminary assessment survey, preparatory to a comprehensive ERDA sponsored watershed study, was conducted in the vicinity of Sheridan, Wyoming on the Tongue River and its major tributaries during the summer of 1975 to determine the extent and magnitude of aquatic environmental impacts induced by strip mining of coal at one major mine in the western Powder River Basin of Wyoming. Results of detailed physical and chemical analysis of mine discharge and ambient water quality of receiving streams were not conclusive, but suggest that water quality impacts of present mining activities in the area examined are small when compared to other apparent land use impacts observed upstream of the mine.

26486 (LSU-SG—73-01) **Microbial degradation of oil pollutants. Workshop held at Georgia State University, Atlanta, December 1972.** Ahearn, D.G.; Meyers, S.P. (Louisiana State Univ., Baton Rouge (USA). Center for Wetland Resources). 1973. 322p. Louisiana State Univ., Baton Rouge.

Separate abstracts were prepared for the 32 papers presented at the workshop. (HLW)

26487 (LSU-SG—73-01, pp 1-2) **Microbial-facilitated degradation of oil: a prospectus.** Ahearn, D.G. (Georgia State Univ., Atlanta). 1973.

In Microbial degradation of oil pollutants.

The following areas of research on biodegradation of oil are briefly discussed: microbial utilization of hydrocarbons; practical applications for a controlled microbiological process of fossil hydrocarbon conversion; microbial treatments to reduce toxicity following oil spills; and enzymatic processes for biodegradation of the recalcitrant fractions of crude oils. (HLW)

26488 (LSU-SG—73-01, pp 3-16) **Microbial degradation of oil: present status, problems, and perspectives.** ZoBell, C.E. (Scripps Institution of Oceanography, La Jolla, CA). 1973.

In Microbial degradation of oil pollutants.

The following topics are discussed briefly: occurrence of hydrocarbon oxidizers in nature; kinds of hydrocarbon oxidizers; kinds of hydrocarbons oxidized; factors affecting the microbial degradation of oil; criteria for the microbial degradation of oil; biodegradation products; rate of oil degradation; oil in food chains; artificial seeding of oil spills; and fate of oil in bottom deposits. (HLW)

26489 (LSU-SG—73-01, pp 199-203) **Alkane degradation in beach sands.** Ahlfeld, T.E.; LaRock, P.A. (Florida State Univ., Tallahassee). 1973.

In Microbial degradation of oil pollutants.

An estimation of the rate of n-alkane degradation was made in beach sands from Coal Oil Point, California. Bulk sand samples from a beach chronically polluted with oil from natural seeps were extracted and analyzed gas chromatographically and gravimetrically for hydrocarbon content. Calculations indicate that a maximum degradation of 0.32 g of n-alkanes occurs per day for 100 m^2 of beach. The oil input on the day of sampling was estimated to be 5 g/100 m^2/day. From these figures it is seen that the daily maximum oxidation, including bacterial degradation, evaporation and autoxidation, accounts for only 6 percent removal of the alkane content of the sand.

26490 (LSU-SG—73-01, pp 205-220) **Hydrocarbons of suspected pollutant origin in aquatic organisms of San Francisco Bay: methods and preliminary results.** DiSalvo, L.H.; Guard, H.E.; Hunter, L.; Cobet, A.B. (Univ. of California, Berkeley). 1973.

In Microbial degradation of oil pollutants.

Large amounts of petroleum-derived hydrocarbons enter the waters of San Francisco Bay each year, yet little is known concerning the fate and effects of pollutant hydrocarbons on estuarine organisms and, indirectly, on the human environment of the Bay area. Investigation into fate and effects of petroleum-derived hydrocarbons was initiated by analyzing the hydrocarbon content

of selected Bay animals to determine if this served as an indicator of chronic hydrocarbon pollution in Bay food chains. Initial results have been obtained using solvent extracts of sponge, mussel, and crab tissues. Closely related animals were obtained from relatively clean waters along the northern California coast to provide "unpolluted" control extracts for comparison. To date, it has been shown that Bay organisms have a significantly higher content of hydrocarbons than the clean water organisms. Methods tested included gas chromatography (GC), thin layer chromatography (TLC), fluorescence spectrometry, and high pressure liquid chromtography (HPLC). Comparative results between the different methods suggest thin layer chromatography to be the method of choice.

26491 (LSU-SG—73-01, pp 275-278) **Inhibition of bacterial chemoreception by hydrocarbons.** Walsh, F.; Mitchell, R. (Harvard Univ., Cambridge, MA). 1973.

In Microbial degradation of oil pollutants.

A wide variety of chemical and physical water pollutants is shown to inhibit microbial chemotaxis. Such chemotaxis inhibition may have direct effects on microbial predator-prey relationships or on the rate of degradation of organic substrates in the sea.

26492 (LSU-SG—73-01, pp 279-282) **Degradation of crude oil by yeasts and its effects on Lesbistes reticulatus.** Cook, W.L.; Massey, J.K.; Ahearn, D.G. (Georgia State Univ., Atlanta). 1973.

In Microbial degradation of oil pollutants.

High densities of hydrocarbonoclastic yeasts have been isolated from oil-enriched fresh and marine waters (2,5). Certain strains, mainly from sites affected by chronic oil pollution, have demonstrated relatively high rates of oil oxidation and emulsification and the ability to utilize various hydrocarbons (2,4). These observations have suggested that yeasts may possibly be utilized to facilitate degradation of oil pollutants. If high concentrations of microorganisms are dispersed as inocula "seed" into the environment, careful attention should be given to the potential pathogenicity and toxicity of their metabolites for the natural biota. Two hydrocarbonoclastic yeasts, Candida tropicalis and Endomycopsis lipolytica (perfect stage of C. lipolytica) selected for the aforementioned hydrocarbon-utilization activities, have been examined in combination with crude oils for their effects on the mortality of the common guppy, Lesbistes reticulatus.

26493 (LSU-SG—73-01, pp 283-289) **Effects of some commercial oil herders, dispersants, and bacterial inocula on biodegradation of oil in seawater.** Atlas, R.M.; Bartha, R. (Rutgers—the State Univ., New Brunswick, NJ). 1973.

In Microbial degradation of oil pollutants.

The effects on petroleum biodegradation of several oil herders, dispersants and commercial bacterial inocula were tested. The oil herders and dispersants significantly increased the rate of mineralization but not the extent of petroleum biodegradation. The beneficial effect is apparently due to the increased surface of oil droplets and an absence of toxicity to oil degrading microorganisms at the recommended concentrations. The two commercial bacterial inocula tested failed to improve either the rate or the extent of oil biodegradation when tested in natural seawater. In sterile seawater, these inocula showed inferior performance compared to the natural microflora of seawater, and were judged to be ineffective for marine applications. Data on the safety and effectiveness of available oil pollution control products are basic to their correct use. While numerous studies have been conducted on the toxicity of such products to vertebrates and invertebrates little is known about their effects on the indigenous microflora of the sea. Since microbial degradation is the major natural process for the ultimate destruction of polluting oil, it is essential that this process not be interfered with. The recommended concentrations of two oil herders, six dispersants and two bacterial inocula were tested for their effects on the biodegradation of Swedish crude oil in freshly collected seawater samples.

26494 (ORNL-tr—4109) **Carcinogens in water and soil. XIX. Effect of sewage purification on polycyclic aromatic compounds.** Boneff, J.; Kunte, H. Translated by H. Tobias from *Arch. Hyg. Bakteriol.*; **151**: 202-210(1967). 9p. Dep. NTIS $3.50.

Sewage from households and industry, as well as from roads, carries considerable quantities of polycyclic hydrocarbons. Primary settling reduces carcinogen content by about half, but more effective is an activated sludge treatment. Therefore, only modern purification plants with two grades guarantee a reduction to a concentration of carcinogens corresponding to that of river water. Most of the carcinogens concentrate in sewage sludge during the purification and, in this way, affects its quality as fertilizer. The polycyclic hydrocarbons represent an indicator in refining river water to drinking water.

26495 Proceedings of the 29th industrial waste conference. Conference held at Lafayette, Indiana, May 7, 8, and 9, 1974. Bell, J.M. (ed.). Lafayette; Purdue University (1974). 571p. (CONF-7405111—P1).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

Individual abstracts were entered for 21 papers.

26496 Recycle of wastewater from vehicle washracks. Chian, E.S.K.; Gupta, A. (Univ. of Illinois, Urbana). pp 9-20 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

The objective of this study was to treat the waste stream from vehicle washrack operations with reverse osmosis and ultrafiltration processes, and to reuse the treated water. Also, work was conducted to identify the composition of the contaminants in the washrack wastewater, and to formulate the synthetic waste for evaluating the ability of membrane processes to remove these contaminants. Results provided a basis for establishing effluent criteria for reuse and for designing membrane treatment facilities. (PCS)

26497 Aqueous-phase catalytic oxidation as wastewater treatment technique. Katzer, J.R.; Sadana, A.; Ficke, H. (Univ. of Delaware, Newark). pp 29-35 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

Aqueous phase catalytic oxidation of phenol to CO_2 and H_2O over supported copper oxide was studied. Rate data obtained were used in the design of an aqueous-phase catalytic oxidation process. The economic evaluation of the process was then compared with that for other physical-chemical processes. The technique has application at large coal conversion and shale oil recovery plants located in arid or cold regions. Catalytic oxidation appears worthy and economically attractive for wastes containing high organic concentrations. Energy requirements to heat the waste stream high enough for oxidation makes it unattractive economically for low concentrations. (PCS)

26498 Aerospace industrial waste pretreatment. Stone, R.; Smallwood, H. (Ralph Stone and Co., Inc., Los Angeles). pp 51-59 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

Wastewater treatment methods in the aerospace industry were assessed for their ability to achieve the zero discharge goals of the FWPCA Amendments of 1972. Four specific industrial processes are examined: metal plating, metal finishing, soluble oil recovery, and brine-zeolite water softening. Conclusions were made that chromium, cadmium, nickel, and tin plating wastes would be treated separately via a system of stock tanks, sump tanks, treatment stations, reservoirs, sump pumps, and metering pumps, pH control is an important factor. Typical capital plus operating and maintenance costs were $8300 with $4400 savings predicted if cooling water is reused. For treating water soluble cutting oil, a bactericide can be added and metallic fines recovered by using a settling tank from which the non-soluble oil contaminants are skimmed. Savings estimated to be about $37,000/yr. can be achieved by prolonging the life of the cutting oil rather than disposing of spent oil. For brine waste produced from water softening, disposal currently seems to be the only economical alternative. The break-even point for treatment technology was estimated to be $960. (PCS)

26499 Odors and malodors: removal, destruction, and modification. Lauren, O.B. (Photonic Environmental Corp., Chicago). pp 60-66 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

Hydrogen sulfide control has become necessary from increased natural gas processing, petroleum refining, coal combustion, metallurgical processes, and paper industry in addition to sewage treatment and other causes. Cataban, a patented process using liquid-phase catalytic oxidation, was studied for its effectiveness in H_2's odor removal. Formaldehyde was studied for destruction viruses and bacteria associated with malodors. Alternative methods of odor masking were considered with cautions noted for masking any potentially toxic gas or vapor. (PCS)

26500 Contamination of an aquifer by salt water injection. Woods, C. (Texas A and M Univ., College Station). pp 141-147 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

Oil field brines were investigated as a source of groundwater pollution in North-Central Texas. Forty samples were analyzed for electrical conductivity, manganese, barium, sodium, calcium, potassium, magnesium, iron, nickel and lead. Although there was no widespread pollution, numerous cases of local pollution of fresh water wells were discovered. This pollution was caused by surface spillage, improperly designed, improperly maintained, and operated injection wells, and unplugged holes. (PCS)

26501 Waste lead oxide treatment of lead acid battery manufacturing wastewater. Crandall, C.J. (Marquette Univ., Milwaukee); Rodenberg, J.R. pp 194-206 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

Pilot plant experiments established the basic parameters for the neutralization of lead-acid battery manufacturing process wastewater with lead oxide. Under the right conditions, it was established that the process is capable of producing a filtered effluent containing less than 1.0 mg/l of lead. More development work is required to optimize the flocculating chemical dosage. (PCS)

26502 Deep sea ocean disposal of petrochemical plant wastes. Ball, J. (Texas A and M Univ., College Station); Reynolds, T.D.; Beckett, D.E. pp 223-229 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

In compliance with recent EPA requirements for dye-dispersion studies prior to obtaining a permit for ocean disposal of petrochemical plant wastes, two dispersion studies are presented. An analysis combines the current data with literature studies and enables a formula to be developed for the dispersion phenomena. The rate at which the waste dilutes with sea water appears to be a function of the difference in specific gravity between the waste and the sea water. Dilution concentration at an arbitrary time after dumping of one minute was a function of speed of the barge and the rate of release. Before other parameters can be considered, more costly studies must be undertaken. (PCS)

26503 Treatment of refinery wastewater using filtration and carbon adsorption. McCrodden, B.A. (BP Oil Inc., Marcus Hook, PA). pp 230-244 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

A 2.2 MGD filtration carbon adsorption wastewater treatment plant, placed in operation at a refinery, has demonstrated overall removals of 76, 89, 42, 38, and 39 percent reduction for suspended solids, oil, first stage ultimate oxygen demand, chemical oxygen demand, and phenol, respectively. A schematic flow diagram of the treatment facilities is included. A solids handling system was designed to separate the sludge removed at the filters, API separator, and emulsion treater into an oil, water and solid phase. Upon separation, oil is recovered, the water is returned for reprocessing, and solids are disposed on a sanitary landfill. Oil recovery has approached 20 gpm. on occasion. Spent carbon regeneration has been achieved using a six-hearth furnace fired by refinery fuel gas. (PCS)

26504 Operation and performance of a refinery wastewater carbon adsorption plant. Prosche, M.A.; Loop, G.G.; Strand, R.P. (Atlantic Richfield Co., Carson, CA). pp 255-261 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

A wastewater treatment plant was selected for impounding rain water plus refinery process water during a storm followed by activated carbon adsorption for removal of total chemical oxygen demand before release into a freshwater stream. The plant proved easy to maintain, easy and quick to start up, simple to shut down and leave in a standby stage, and very reliable in performance. Operating costs ran about 40 cents per 1,000 gallons of water treated or 18 cents per pound of COD removed. Only intermittant type operation was studied. (PCS)

26505 Removal of oil from dilute aqueous emulsions by autocoacervation and coalescence in carbon-metal granular beds. Brown, W.P. (Nalco Chemical Co., Chicago); Ghosh, M.M. pp 357-369 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

The main objective was to study the feasibility of using bimetallic, porous-bed coalescers in the separation of oil from dilute oil-in-water emulsions commonly encountered in many industrial waters (automotive plants, chemical processing plants, oil refineries, and steel mills). Operational effects of depth of bed, superficial velocity and porosity of the granular medium as related to packing of bed material on removal efficiency were studied. Effects of the size of dispersed oil on its removal was also studied in qualitative fashion. Carbon-aluminium beds consistently yielded better quality effluents than the carbon-iron beds in terms of effluent oil and metal concentrations, with lower headlosses. In the velocity range of 3 to 9 gpm/sq. ft., an increase in flow rate was found to have an inverse effect on the removal efficiency for both types of beds. Mixed bed performance was inversely proportional to the porosity within the range of 0.4 to 0.48 pores. The useful life of carbon-iron beds was only weakly dependent on the flow rate while carbon-aluminium beds showed a marked dependence. Headloss was significantly increased by decreasing porosity and increasing flow rate. (PCS)

26506 Water quality management of leachates from power station coal ashes. Weeter, D.W. (Univ. of Pittsburgh); Niece, J.E.; Digioia, A.M. Jr. pp 420-428 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

Environmental aspects of the water pollution problem associated with coal ash disposal are discussed. Experiments were conducted to determine optimal ash washing times and to determine, as a function of fill depth and amount of surface water percolation through the fill, the expected years of unsatisfactory leachate quality. The possibility of coal ash fills becoming potential future mineral recovery areas is discussed. Site development should involve the construction of an impermeable surface for two reasons: (1) prohibit leachate formation and therefore not require leachate treatment, and (2) prohibit leaching, and wastage, of possible future recoverable minerals. (PCS)

26507 Treatment of wastewater from the manufacture of polystyrene. Mason, W. (Foster Grant Co., Inc., Leominister, MA); Allen, G.S. pp 472-483 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

Process and equipment used for wastewater treatment at three separate plants is described. All plants are similar and use ferric sulfate, sodium aluminate, and polyelectrolyte chemicals for treatment. Reliability, performance and economics are presented. (PCS)

26508 Water reuse and treatment at an integrated wire and cable plant. Tropea, L.C. Jr. (Reynolds Metals Co., Richmond); Hulcher, B.S.; Browne, F.X. pp 484-496 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

Basic study objectives were to (1) characterize plant wastewater discharges, (2) evaluate wastewater reuse possibilities; and (3) develop a comprehensive wastewater reuse and treatment program. As a result of the study the Banbury Rubber Mill scrubber was replaced with a baghouse, while a waster water displacement tank will be provided at the Kenworthy Annealer to eliminate the wastewater discharge there. Many recommendations for containing or repairing oil leaks were made, plus certain housekeeping suggestions. While the capital cost of the program was slightly over one-half million dollars, it has been estimated that the decreased cost of purchased water will nearly offset that cost. (PCS)

26509 Feasibility of reclaiming the industrial waste generated from an aircraft power check facility. Huang, J.C. (Univ. of Missouri, Rolla); Austin, D.S. pp 519-523 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

When a literature search revealed no available information regarding water usage and waste production associated with aircraft power check operations using a sound suppression unit, two experimental studies were conducted with dissolved air flotation system and chemical clarification followed by sand filtration. The ineffectiveness of the air flotation method prompted the chemical clarification and sand filtration investigation which proved more economical as well as more effective for reclaiming the water. A filtration rate of 5 gpm/sq. ft. through an 18-inch depth sand column produced a fairly clear effluent lacking in oil residual. However, chemical clarification of carbon soot was necessary to prevent filter clogging. Alum and ferric chloride were evaluated with alum proving more effective coagulant, after addition of soda ash or lime to bring pH of the wastewater to 6.5 which was found necessary for good flocculation. This process contributes to abatement efforts in air pollution, water pollution, noise pollution and resource conservation. (PCS)

26510 Industrial waste treatment at San Francisco International Airport. Lee, E.L. (Consoer, Towsend and Associates, San Jose, CA); Van Kirk, F.N.; Leong, M.; Lee, R.G. pp 535-546 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

The main purpose of this study was to develop and establish an economical treatment process which will meet present and proposed effluent and receiving water standards for California water quality. A survey was made of the airport to determine the nature of each industry, the wastes produced and problems involved in handling the wastes. Operations included metal plating and finishing, aircraft service, aircraft maintenance, aircraft washing, ground vehicle service and maintenance with pollutants generated such as cyanide, chromium and other heavy metals, waste oils, jet fuels, solvents, cleaning agents and other washing compounds, hydraulic fluids, detergent, dirt, and paint sludge. Treatment processes required include oil and heavy metal removal, suspended solids removal, biological oxidation of organic substances and disinfection. (PCS)

26511 Proceedings of the 29th industrial waste conference. Conference held at Lafayette, Indiana, May 7, 8, and 9, 1974. Bell, J.M. (ed.). Lafayette; Purdue University (1974). 641p. (CONF-7405111—P2).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

Individual abstracts were entered for 17 papers.

26512 Laboratory studies into the reduction of pollution from poultry processing by in-plant recycle. Berry, L.S.; Lafayette, P.F.; Reed, S.W.; Woodard, F.E. (Univ. of Maine, Orono). pp 574-588 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Feasibility of reclaiming and recycling process waters within a poultry processing plant was studied. Wastewater samples from three sources in the processing plant were subjected to physico-chemical treatment processes, including chemical coagulation, dissolved air flotation, sand filtration and activated carbon absorption to determine performance characteristics of each process on each wastewater type. It was concluded that both a physico-chemical system and an activated carbon column adsorption system could be developed successfully. While no one polymer was singled out as being best for treatment of chiller water, several were approximately equal in their ability to remove suspended solids. It was felt coagulation followed by dissolved air flotation could be used effectively to prepare poultry processing wastewater for filtration followed by carbon adsorption leading to in-plant recycle. (PCS)

26513 Treatment of a high strength phenolic and ammonia wastestream by single and multi-stage activated sludge processes. Adams, C.E. Jr. (Associated Water and Air Resources Engineers, Inc., Nashville). pp 617-630 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

In evaluation of the potential of biological treatment for a weak ammonia liquor from a coke plant which had been pretreated by multi-stage flash evaporation, it was concluded that high concentrations of phenol and ammonia can be treated biologically in the activated sludge process. This assumes well-acclimated sludges and the absence of toxic constituents which may inhibit the nitrifiers. Influent cyanide levels of 3.5 mg/l did not appear to affect the nitrification capacity of the systems and effluent cyanide levels of about 0.1 mg/l resulted in all cases. Under the best controlled conditions, it would be difficult to predict effluent phenol levels less than 0.16 mg/l for 50 percent of the time. (PCS)

26514 Role of pretreatment in the removal or organics from industrial wastewater. Eller, J.M. (Engineering Science, Inc., Houston, TX); Gloyna, E.F. pp 640-647 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

The objective of this paper is to establish the importance of lime pretreatment for removal of organics. Three case histories are provided to illustrate the role of pretreatment for removal of (1) insoluble hydrocarbons, (2) soluble and insoluble hydrocarbons plus inorganic particulates and precipitated inorganics. Discussion is included on neutralization, coagulation, flocculation, and gravity separation for waste derived from a projected regional treatment system, a typical large oil refinery, and a synthetic fibers plant. (PCS)

26515 Economics of coal mine drainage treatment. Bhatt, H.G. (Micheal Baker, Jr., Inc., Beaver, PA). pp 686-703 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

The capital and operating costs of the following coal mine drainage treatment methods are discussed: (1) neutralization (acid mine water with either high ferrous or ferric iron content); (2) flash distillation; (3) ion exchange; (4) reverse osmosis; (5) submerged coal refuse combustion process; (6) freezing; (7) electrodialysis; (8) foam separation; and (9) neutradesulfating process. Most existing treatment plants use lime neutralization; only a few use limestone. Other methods are too costly for pollution control only but are justified if the treated water provides domestic or industrial water supply. (PCS)

26516 Grease problems in municipal wastewater treatment systems. Banerji, S.K.; Robson, C.M.; Hyatt, B.S. Jr. (MCA Engineering Corp., Baltimore). pp 768-781 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Economic analysis of providing grease, fat, and oil removal facilities prior to discharge to the sewerage system compared with removal facilities at the wastewater treatment plant itself is considered. Methods for analysis, problems created by their presence, and available technology for removal of this material is discussed. The removal treatment example refers to poultry wastewater but has applicability to wastes of petroleum and oil refineries and other industrial and municipal wastes. (PCS)

26517 Factors to consider when selecting granular activated carbon for wastewater treatment. BeJohn, P.B. (ICI America Inc., Wilmington, DE). pp 790-807 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana,. United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Selection criteria for granular activated carbon includes: (1) ability to adsorb impurities so that effluent standards can be met; (2) reasonable carbon regeneration losses; (3) minimal pressure drop; and (4) lowest operating cost. Comparative performance for the two carbon types are reported from fifty studies using municipal and industrial wastes. It was concluded that wastes of predominantly large molecules (oil refineries, textile and dye plants, pulp and paper mills) respond to lignite carbon while small molecules respond best to bituminous coal carbon. Regeneration losses and operating problems were essentially equivalent. (PCS)

26518 Pollution control in the explosives industry. Patterson, J.W. (Illinois Inst. of Tech., Chicago); Minear, R.A. pp 808-831 of

In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Pollution abatement technology is available for waste processing in the explosives industry but has not been implemented effectively. Volume and concentration of wastewaters can be reduced by close process control, improved housekeeping practice, and separation of contaminated and clean process flows. Dry cleanup procedures have potential to reduce pollutant discharges with benefits of product recovery and water use reduction. Ion exchange and reverse osmosis promote both efficiency and product recovery for ammonium nitrate, sulfates and acetone. Waste oil is easily skimmed and often used on dirt roads within plant boundaries for dust control. (PCS)

26519 Removal of heavy metals from wastewater by adsorption on sand. Netzer, A.; Wilkinson, P. (Canada Centre for Inland Waters, Burlington, Ont.). pp 841-845 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Public awareness of health hazards of heavy metals and their effects on environment and public health prompted investigation of their removal from wastewater using commercial filtration sand. Experiments measured the sand's effectiveness for aluminum, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, silver and zinc from aqueous solutions. All metals were studied in pH range of 3 to 11. Only minimal adsorption was observable although adsorptive capacity increased with the pH. Due to the large quantities of sand required per volume of water treated, sand was concluded to be both economically and technically unattractive. (PCS)

26520 Pollution abatement in the lead mining district of Missouri. Ryck, F. Jr.; Whitley, J.R. (Missouri Dept. of Conservation, Columbia). pp 857-863 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Biological conditions in three streams prior to and after the start of lead mining and milling are documented and the effectiveness of mill effluent recycling and stream channel modification as pollution abatement techniques are reported. (PCS)

26521 Treatment of two coke plant wastewaters to meet guideline criteria. Adams, C.E. Jr.; Stein, R.M.; Eckenfelder, W. Jr. (Associated Water and Air Resources Engineers, Nashville). pp 864-880 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

The quantity, source and treatability of waste from coke to plants are discussed relative to EPA guidelines with the possible misapplication of the guidelines to certain parameters. Both aerated lagoon and activated sludge processes were examined on bench-scale basis. Pretreatment offered no performance advantage except for reduction of foaming. The lagoon system functioned better than the activated sludge. Ammonia appears to be the constituent which will require the most intensive and expensive means of control. (PCS)

26522 Ultimate disposal of liquid wastes by chemical fixation. Conner, J.R. (Division of Environmental Sciences, Inc., Pittsburgh). pp 906-922 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Advantages of chemical fixation and solidification are considered for the ultimate disposal of waste materials that have been recycled as far as economically feasible. The Chemfix process produces a non-toxic, environmentally-safe material that can safely be used as a landfill. The system, no patented, utilizes a two-part inorganic chemical system which reacts with all polyvalent metal ions and with certain other waste components. It also reacts within itself to form a chemically and mechanically stable solid. The resultant matrix is a pseudo-mineral that displays properties of high stability, high melting point, and a rigid, friable structure, very similar to many soils. No solubilization of metals is evident under even severe acid conditions. This process has been successfully used on wastes from petrochemical, steel, automotive, electronics, electric utility, chemical, and metal finishing industries as well as experimental work in sewage, dredging and landfill areas. Ecological desirability and cost-benefit attractiveness herald this process as an increasingly important and effective tool in the ultimate waste disposal field. (PCS)

26523 Water quality limited approach to effluent reduction in paper manufacture. Springer, A.M. (Air and Stream Improvement, Inc., Kalamazoo, MI); Marshall, D.W.; Gillespie, W.J. pp 945-963 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Accumulated useful data on water reuse in combination paperboard manufacture is presented. Water conservation efforts by mills to reduce their water consumption from 55,000 to 2-3,000 gallons per ton of board production have met with minor difficulties. The six basic problems are slime, odor, corrosion, scale, product mottle, and plugging. A computer program was developed to compare water sample composition to all proposed water quality standards. In general, data showed that a much lower quality of water can be used in various applications than previously suspected by equipment manufacturers or mill technical personnel. Flow diagrams are presented for solutions to come of these difficulties. Surge capacity will be required in closed systems to prevent losses due to upsets and BOD loading as discharged per ton of product can be significantly reduced through implementing a water reuse program. (PCS)

26524 Major airport industrial waste pollution abatement, a comprehensive program. Clark, E.E.; Fink, J.L. (Connel Associates, Inc., Miami). pp 978-989 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Studies were conducted to determine best and most economical method of collection, treatment, and disposal of industrial wastes from the Miami International Airport. Objectives were: (1) to intercept and collect dry-weather industrial waste flows; (2) to provide adequate pre-treatment of those flows; (3) to intercept floating wastes reaching canal receiving waters; and (4) to establish a constant and continuous monitoring program for receiving waters. The planned pollution abatement program is now being instituted. (PCS)

26525 Dewatering characteristics of sludge from industrial oxygen activated sludge systems. Romagnoli, R.J. (Union Carbide Corp., South Charleston, WV). pp 990-1004 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Results are presented for the dewatering of oxygen-activated sludges, in addition to a description of the Union Carbide Sludge Dewatering Laboratory Van. Data are included from two petrochemical companies. Emphasis is put on the ease and desirability of running a bench-scale pilot sludge dewatering study at each industrial site. Design parameters can be determined, costs can be assigned to each unit process and overall system can be optimized. Data can be used to directly produce full scale unit processes for sludge handling and disposal. (PCS)

26526 Trace element study in the Thames estuary. Bevan, C.D.; Harbison, S.A.; Nelson, L.A.; Lakey, J.R.A. (Royal Naval Coll., Greenwich (UK)). pp 93-105 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June - 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The paper reports a study of the trace element concentrations in part of the Thames Estuary, a partially enclosed area of water. The concentration of the trace elements in the 'dissolved fraction' and the 'non-dissolved fraction' of the water and in the sediment is reported and relationships between these elements are sought. This information may be important in predicting transport mechanisms for trace elements and gives an indication of their fate. Neutron activation analysis was selected for this study but preconcentration was required for elements in the dissolved fraction. Chelex-100 resin was used to selectively remove cobalt, zinc,

chromium, mercury and scandium from the water matrix. All elements except mercury were reproducible with a coefficient of variation less than 20%. Ultraviolet absorbance (to give an indication of organic content) and salinity were recorded for samples taken at points spanning the Estuary in Sea Reach. All other fractions were subject to instrumental neutron activation analysis and all results were correlated for every pair of elements in each sample component. Six groups of elements were identified with correlations which indicated relationships within each group. The most important group was common to the muddy sediment and the non-dissolved fraction in the water. There were no strong correlations in the dissolved fraction but cobalt, zinc and chromium were linked with UV absorbance and salinity. Iron, cobalt, chromium and hafnium did not align with the main grouping and possible mechanisms for these differences are suggested.

26527 Environmental behaviour of the binuclear oxygen-bridged nitratonitrosylruthenium complex. Nishiwaki, Y. (Kinki Univ., Fuse, Osaka (Japan). Atomic Energy Research Inst.); Honda, Y.; Kimura, Y. (Kinki Univ., Higashi-Osaka, Osaka (Japan). Faculty of Science and Technology); Ishiyama, T.; Matsumura, T.; Mamuro, T. (Radiation Center of Osaka Prefecture, Sakai (Japan)). pp 107-118 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The physico-chemical behaviour of prepared binuclear oxygen-bridged nitratonitrosylruthenium, $[RuO_2(NO)_2(NO_3)]_2O$, was investigated by filter paper electrophoresis, paper chromatography, and infrared absorption spectra of a decomposition product in fresh water. The binuclear (Ru-O-Ru) nitrate complex in aquatic systems was electrophoretically fractionated into at least four 'anionic' species, one 'neutral' species and one 'cationic' species, with aging, and about 75% of the total Ru was present in the anionic fractions. It was found that about 90% of the total Ru in the solution was taken up in the fraction with Rsub(f) less than 0.2, corresponding to the anionic mononitro-, mononitrato- and probably the polynuclear species from paper chromatography. The proportions of Rsub(f) 0-0.2 and Rsub(f) 0.2-1.0 to total Ru were scarcely altered by increasing the aging time more than one day. On the basis of infrared spectra of decomposition product by aging the (Ru-O-Ru) nitrate, it was confirmed that two oxide anions, nitrosyl, nitro, nitrato groups and water molecule are all coordinated to Ru metal, assuming $[RuO_2(NO)(NO_2)(NO_3)(H_2O)]^-$ as one of the possible chemical forms of the anionic species. RuNO-nitrato, RuNO-nitro and (Ru-O-Ru) nitrate complexes were entirely adsorbed by the addition of 500-700 ppm of activated carbon produced from coconut shell by batch equilibrium test. In spite of the high concentration of natural ion exchangers, the percentages of adsorption of these complexes were not observed to be very high.

26528 Conventional and radioactive pollutants of inland waters in Austria. Ottendorfer, L.J. (Federal Inst. of Water Control, Vienna, Austria). pp 395-402 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The hydrological and orographic situation of Austria is described. Water quality and the organization of its control are discussed. The results of these investigations are converted into water quality maps issued in regular intervals. The importance of pollution abatement in lakes is mentioned. The Austrian Danube is taken as a typical example of a conventionally polluted river. Complications arising from the construction of hydroelectric plants are discussed and the different sedimentation and the risks of deoxygenation are considered. The radiological control of inland waters was started in 1961 after the nuclear test series. The data collected from 16 sampling points at monthly intervals serve now as the guideline for the issue of licences for nuclear power plants and the limits for radiological releases. The radiological data so far collected by the Federal Ministry of Health and Environmental Protection cover atmospheric and aqueous contamination. A Federal Law regulates the maximum permissible impacts on the population and the environment. All relevant data are issued regularly by the above mentioned Ministry. The influence of already existing and planned nuclear power stations in the neighbouring countries (upstream of Austria: Switzerland, Federal Republic of Germany, Czechoslovakia) is considered. Radiological control in connection with the first Austrian nuclear plant (capacity 700 MW) and the following ones is discussed. The initiatives of several international organizations to install a multinational control system are mentioned. The system would be planned for all riparian countries of the Danube catchment area.

26529 Studies on rare earth elements in seawater and uptake by marine organisms. Suzuki, H.; Koyanagi, T.; Saiki, M. (National Inst. of Radiological Sciences, Chiba (Japan)). pp 77-89 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June - 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The contents of rare earth elements in marine environmental samples were determined by neutron activation analysis to examine the existing state in coastal seawater and the concentration by marine organisms of the elements. Seawater was filtered through a Millipore filter GS (pore size 0.22 μm), before the analysis. Some of the seawater was treated with HCl solution before filtration and some after filtration. Certain marine organisms were also analysed for determination of rare earth elements. These were: flounder (Paralichthys olivaceus); yellowtails (Seriola quinqueradiata); immature anchovy (Engraulis japonica); clams (Meretrix lusoria); green algae (Ulva pertusa); brown algae (Hizikia fusiforme, Sargassum fulvellum, Undaria pinnatifida). In the seawater without HCl treatment before filtration, considerable amounts of the elements existed in residue on the filter, whereas in the seawater treated with HCl before filtration, the greater part remained in the dissolved state. Concentration factors calculated from the contents of stable elements, therefore, are affected remarkably by the existing state of the elements in seawater. If only the dissolved state is assumed available for marine organisms, values one order higher are attained compared with the case where total amounts of the elements were used for the calculation. However, the contribution of the insoluble state seems to be not negligible with some organisms. The higher concentration factors for immature anchovy and clams observed in this study were considered to be caused by surface adsorption of elements in particulate form and also ingested sediment with high element concentration.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 25492, 26184, 26437, 26438, 26446, 26461, 26462, 26464, 26466, 26472, 26528, 26650

26530 (PB—241896) **Cooperative phenomena in isotopic hydrodynamic dispersion. Project report No. 30.** Case, C.M.; Carnahan, C.L. (Nevada Univ., Reno (USA). Center for Water Resources Research). Apr 1975. Contract DI-14-31-0001-3828. 91p. NTIS $4.75.

The study theoretically examines the effects on the rate of hydrodynamic dispersion of two types of dispersing material - isotopic (tritium) and suspended - as an example of cooperative phenomena using statistical mechanics. By these means a preliminary formula describing hydrodynamic dispersion in relation to pollutants in water was developed. For clusters with higher binding energy, corresponding either to a higher concentration of isotopes or larger atomic numbers, e.g., tritium versus deuterium, more thermal energy is required to achieve a given level of dispersion. For removal of water molecules from the cluster, the curves of entropy versus temperature lie below each other as successive configurations contain fewer and fewer radioactive isotopes. Lower concentrations of radioactive isotopes mean lower binding energy in the cluster and hence less energy is necessary to go from one configuration to the next. The relative values of Helmholz free energy and entropy are of use in describing the diffusion of deuterium and tritium in water. (GRA)

26531 Cross-flow filtration and axial filtration. Kraus, K.A. (Oak Ridge National Lab., TN). pp 1059-1075 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Two relatively novel alternative solid-liquid-separation techniques of filtration are discussed. In cross-flow filtration, the

feed is pumped past the filtering surface. While in axial filtration the filter, mounted on a rotor, is moved with respect to the feed. While large-scale application of the axial filter is still in doubt, it permits with little expenditure of time and money, duplication of many hydrodynamic aspects of cross-flow filtration for fine-particle handling problems. The technique has been applied to municipal wastes, low-level radioactive waste treatment plant, lead removal from industrial wastes, removal of pulp-mill contaminants, textile-mill wastes, and pretreatment of saline waters by lime-soda process in preparation for hyperfiltration. Economics and energy requirements are also discussed. (PCS)

26532 Behaviour of plutonium and other long-lived radionuclides in Lake Michigan: II. Patterns of deposition in the sediments. Edgington, D.N. (Argonne National Lab., Ill. (USA)); Robbins, J.A. (Michigan Univ., Ann Arbor (USA). Great Lakes Research Div.). pp 245-259 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

At present eight operating nuclear power reactors, and one more which will be in operation by 1980, are situated along the shores of Lake Michigan. Since their releases of radioactivity have been much less than that entering the lake from stratospheric fallout, sup(239,240)Pu and ^{137}Cs from the latter source have been measured in order to attempt to predict the depositional patterns of long-lived radionuclides in the lake. Ninety-seven percent of the sup(239,240)Pu and ninety-five percent of the ^{137}Cs that has entered the lake by wet and dry deposition of atmospheric fallout now reside in the sediments. The vertical distribution of ^{137}Cs has been measured in 60 sediment cores, and sup(239,240)Pu in 14 cores taken from all over the lake. The sampling locations were chosen to be representative of the various types of sedimentation, namely areas with high sedimentation associated with river inputs, offshore locations where organic-rich, very fine-grained material is settling out, and areas of low sedimentation where erosion may be occurring. The results of these studies indicate that the scavenging of sup(239,240)Pu and ^{137}Cs appears to occur at the same overall rate but controlled by different processes in the water column. Analysis of the profiles shows that the sedimentation rate varies by more than an order of magnitude and that the total content of these two radionuclides is strongly correlated with the mass-sedimentation rate. As a result, there are large areas of the lake where there is virtually no deposition, and other areas where the total content of ^{239,240}Pu and ^{137}Cs per unit area is several times greater than would be expected.

26533 Adsorption-desorption characteristics of plutonium and americium with sediment particles in the estuarine environment: studies using plutonium-237 and americium-241. Murray, C.N.; Fukai, R. (International Atomic Energy Agency, Monaco-Ville (Monaco). Lab. of Marine Radioactivity). pp 179-191 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The particle formation of plutonium and americium, their adsorption onto fresh water sediments and the desorption from the sediments in sea water were studied in the Laboratory under simulated river-estuary conditions, using γ-emitting plutonium-237 and americium-241. The results of the experiments show that the particle formation of plutonium depends on its valence states, on pH and on the salinity of the medium. For river water at pH4, some 25%, 20% and 30% of the added ^{237}Pu was in particulate form, larger than 0.45 μm, for Pu (III), Pu (IV) and Pu (VI), respectively, while 65%, 90% and 50% of the respective valence states was associated with particles at pH 8. In sea water the general pattern remains similar, although Pu (VI) is more soluble in sea water owing to higher ligand concentrations for carbonate and bicarbonate complexes. The pH-dependency of particle formation of Am (III) is more steep than that of plutonium and seems to be influenced by colloidal substances occurring in the experimental media. The adsorption-desorption characteristics of plutonium and americium with the sediment in river water as well as sea water reflect the characteristics of their particle formation, being dependent upon such properties as valence states, the pH and salinity of the medium. A sewage effluent added to the media has small but measurable effects on the adsorption-desorption processes of plutonium.

26534 Transport and accumulation of radiocobalt in the marine sediment of Urazoko Bay. Nagaya, Y.; Nakamura, K. (National Inst. of Radiological Sciences, Chiba (Japan)). pp 313-328 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

Concentrations of ^{60}Co and other radionuclides in surface sediment samples were investigated in and around Urazoko Bay, Fukui Prefecture, Japan, where a nuclear power plant has been operating since 1969 and the radioactive waste effluent has been released into the sea. The main source of ^{90}Sr and ^{137}Cs was recognized to be radioactive fallout from nuclear explosions, whereas ^{60}Co was considered to originate from the nuclear power reactor. For evaluating radioactive pollution characteristics of the sea bottom, the behaviour of ^{60}Co was investigated using the ^{137}Cs concentration as an indicator of the radionuclide sorption capability or accumulation capability of the sediment. No seasonal variation was observed in the distribution pattern of the ^{60}Co/^{137}Cs ratio and the retention of the heavy initial discharge in 1969 is considered to dominate the radionuclide level in the sediment. The ^{60}Co contamination in the sediment, expressed as the ^{60}Co/^{137}Cs ratio, in this narrow and semi-closed bay was found to vary according to a simple exponential function of the distance from the discharge outlet. It was found that the contamination is spreading out gradually from Urazoko Bay to outer regions. Also the correlation between the amount of discharged radioactive waste and the variation of the ^{60}Co level in the sediment was investigated. The radionuclide extraction efficiency from the sediment for hydrochloric acid was examined and average rates of 70 to 80% for ^{137}Cs and ^{60}Co were obtained, but fluctuations in the efficiencies were sometimes large.

26535 Behaviour of discharged radionuclides from fuel reprocessing operations in the aquatic environment of Bombay Harbour Bay. Pillai, K.C.; Dey, N.N.; Mathew, E.; Kothari, B.U. (Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.). pp 277-299 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; International Atomic Energy Agency (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

Bombay Harbour bay has been receiving low-level liquid effluents from the irradiated fuel reprocessing facility of the Research Centre at Trombay for nearly a decade. The paper gives details of the extensive studies carried out in order to assess the environmental impact of such releases. The interaction of the waste effluents with different matrices of the aquatic environment like sea water, sediment and organisms results in fractionation of the waste constituents and selective accumulation. The interaction and distribution of the radionuclides ^{90}Sr, ^{106}Ru, ^{144}Ce, ^{137}Cs and ^{239}Pu were studied in detail. High accumulation of radionuclides was observed in suspended and bottom sediments. Distribution factors in silt were of the order of 10^3 to 10^5 for Ru, Cs, Ce and Pu. Though the releases of Pu were extremely small, measurable quantities were found to be accumulated near the discharge area. Core samples of bottom sediments near the low water line indicated the pattern of deposition of radionuclides. The nature of the radionuclides in the sediments was investigated. Studies on the uptake of these radionuclides in bay organisms from areas close to the discharge location showed selective accumulation of radioisotopes of Cs and Ru by benthic organisms. Ruthenium-106 accumulated in the Arca shell was found to be mostly in the outer layers of the shell and a significant portion of it was present in the organically bound form. The uptake of Pu by benthic organisms indicated the possibility of higher accumulation of Pu from waste effluents compared to those from fall-out sources.

26536 Effect of sediment displacement on the dispersal of radionuclides. Schaeffer, R. (Electricite de France, 75 - Paris). pp 263-274 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; International Atomic Energy Agency (1975). (In French)

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The bulk of discharged radionuclides are adsorbed by the sediments in water courses. It follows from this that the volumetric activity of the water decreases with distance from the disposal point in an approximately exponential manner. However, the activity accumulated by the sediments deposited on the river bed does not follow this law: the bottom transport to which these sediments are subjected reverses the direction of the variation for them so that their activity increases progressively in the downstream direction, reaching a maximum which may be situated a great distance away after a long period of disposal. In the long term, therefore, the sediments could constitute the main source of irradiation of populations living on river banks fairly far from a disposal point. In view of this variation of sediment activity in time and in space, the paper draws attention to the fact that a very limited number of measurements repeated at a single point is not representative.

26537 System of radiation monitoring, and methods and equipment for measuring water of low specific activity. Sivintsev, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). pp 441-455 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975). (In Russian)

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The author considers criteria for the radiation protection of the population and the environment. He describes the role of procedures for monitoring waters of low specific activity in the framework of a system for ensuring the radiation safety of the population living near a nuclear power station. The main technical characteristics (background, efficiency, sensitivity) of the laboratory equipment for gamma spectrometric analysis of water samples of low specific activity are discussed.

26538 Plutonium in the aquatic environment around the Rocky Flats facility. Thompson, M.A. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). pp 213-225 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The Rocky Flats Plant of the United States Energy Research and Development Administration has been fabricating and chemically recovering plutonium for over 20 years. During that time, small amounts of plutonium have been released with liquid process and sanitary waste discharges. The liquid waste flows through a series of holding ponds from which it is discharged into a creek that is part of a municipal drinking water supply The water flows for about 1.5 km between the last holding pond and the municipal drinking water reservoir. In addition, liquid wastes containing high levels of chemical contaminants and plutonium concentrations less than allowable drinking water standards have been discharged to large evaporation ponds. The fate of the plutonium in both the surface and subsurface aquatic environment has been extensively monitored and studied. It has been found that plutonium does not move very far or very rapidly through subsurface water. The majority of the plutonium released through surface water has been contained in the sediments of the plant holding ponds. Small amounts of plutonium have also been found in the sediments of the draining creek and in the sediments of the receiving reservoir. Higher than normal amounts of plutonium were released from the waste treatment plants during times when suspended solids were high. Various biological species have been examined and plutonium concentration factors determined. Considerably less than 1% of the 210 mCi of plutonium released has been detected in biological systems including man. After more than 20 years of large scale operations, no health or environmental hazard has been identified due to the release of small amounts of plutonium.

26539 Behaviour of ^{90}Sr and ^{137}Cs in the waters of the Baltic Sea. Trusov, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow); Ivanova, L.M.; Zolotukhina, V.S.; Gedeonov, L.I. (Radievyj Inst., Leningrad (USSR)). pp 133-144 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975). (In Russian)

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

On the basis of observed concentrations of ^{90}Sr and ^{137}Cs in the waters of the Baltic Sea and previously published data, the authors estimate the changes in the average values of these concentrations for several years. It is shown that variations in the concentration of ^{90}Sr in general follow changes in the rate of global fall-out of this radionuclide with a considerable delay. It is assumed that ^{90}Sr is very slowly removed from the water mass and that the concentration slowly decreases owing to the shallowness and the isolation of the Baltic Sea. Various other possible reasons are discussed. The distribution of ^{137}Cs in the waters of the Baltic Sea is quite different from that of ^{90}Sr, its content there being much smaller than that of the latter. This is explained by the sorption processes in fresh water and by the flow of caesium-depleted water from the rivers. Factual data are given on the content of ^{90}Sr and ^{137}Cs in the waters of the Gulf of Finland. The presence of these nuclides is due to global radioactive contamination. For the reasons given above the $^{137}Cs/^{90}Sr$ ratio is particularly low here.

WATER

REFER ALSO TO CITATION(S) 25467

AQUATIC ECOSYSTEMS AND FOOD CHAINS

26540 (BNL—21314) Biological consequences of interaction of the climatic and event scales of variability in the Eastern Tropical Pacific. Walsh, J.J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. Contract E(30-1)-16. 47p. (CONF-760907—1). Dep. NTIS $4.00.

From Joint oceanographic assembly; Edinburgh, United Kingdom of Great Britain and Northern Ireland (UK) (13 Sep 1976).

Temporal changes of the Plymouth herring, Atlanto-Scandian herring, Norweigian cod, New York menhaden, Maine lobster, California sardine, anchovy, and red crab, and Japanese herring and sardine are considered in relation to oscillations of Peruvian anchovy and guano bird populations in response to variations of wind strength, of atmospheric and sea surface temperature anomalies, and of current speed for the Eastern Tropical Pacific. It is suggested that marine communities, either off Peru or throughout the ocean, respond in a similar manner to global oscillations at the climatic and El Nino scales by geographical relocation of their centers of abundance. It is further suggested that these two longer scales of variability are minor perturbations of marine ecosystems in comparison with an interaction of overfishing and natural oscillations at the event scale of variability, i.e., that the failure of most of the world's clupeid fisheries may be linked to imposition of this additional stress and the local perturbations of the larval drift of an organism on a time scale of days to weeks.

26541 Fish/water accumulation factor - an important parameter for determining the environmental capacity of surface waters. Ettenhuber, E.; Roehnsch, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). pp 473-481 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The fish/water accumulation factors are important parameters in determining the receiving capacity of surface waters and the maximum permissible concentration of ^{137}Cs in waters used for fishing. In addition, through the pathway water-fish-man, it is possible to evaluate the body burden of man resulting from the ^{137}Cs concentration in waters. For the present work, the ^{137}Cs accumulation factors were determined in certain species of fish from five waters in the German Democratic Republic. Equations are given for determining the reception capacity of waters and the body burden from the ^{137}Cs contamination of water through the ecological chain water-fish-man. Using the experimentally determined accumulation factors, the authors evaluate the body burdens of the individual members of the public and the whole population resulting from the ^{137}Cs contamination of water through this critical pathway. It is concluded that fish production in the contaminated cooling water of nuclear power plants is possible without reservations.

26542 Radiocaesium dynamics in a contaminated floodplain ecosystem in the southeastern United States. Garten, C.T. Jr.; Gentry, J.B.; Pinder, J.E. III; Sharitz, R.R.; Smith, M.H. (Savannah River Ecology Lab., Aiken, S.C. (USA)). pp 331-346 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts

of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The fate of radiocaesium (primarily Cs-137) released into a small stream, Steel Creek, during the operation of nuclear production reactors has been studied. Releases from fuel element disassembly basins occurred concurrently with releases of heat-exchanger cooling water. Cessation of reactor operations reduced stream flow and temperature and permitted colonization of a radiocaesium-contaminated floodplain by plants and animals. Subsequent studies have shown (1) mean radiocaesium concentrations in the soil of approximately 100 pCi/g, (2) considerable spatial variability in sediment radiocaesium concentrations, (3) significant radiocaesium uptake by plants with soil-plant concentration factors usually greater than unity, and (4) appreciable radiocaesium concentrations in animals. Significant uptake by plants occurs because kaolinite, the principal clay mineral in the sediments, does not fix radiocaesium into unavailable forms. Radiocaesium uptake by plants exhibits considerable spatial heterogeneity with radiocaesium concentrations in animals being proportional to plant concentrations. Plant and soil concentrations are not correlated, and the factors causing spatial heterogeneity in plant uptake are currently being investigated. Variability in radiocaesium concentrations between individuals of animal species is less than that observed for plant species. This reduction in variation in concentrations probably occurs because animals are mobile and feed over a large area, thereby integrating widely varying concentrations in vegetation.

26543 Behaviour of caesium-137 in the marine environment. Gilat, E. (Ministry of Agriculture, Haifa (Israel). Sea Fisheries Research Station); Laichter, Y.; Shafrir, N.H. (Technion-Israel Inst. of Tech., Haifa). pp 63-75 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June - 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The radiological impacts of radioactive release from nuclear facilities into aquatic environments can be studied by following the behaviour of fallout radionuclides in the sea, provided that they exist in the same physico-chemical state. Cesium-137 entering the sea from fallout, although found to be at extremely low levels in the marine environment, is still detectable and can be considered representative for the behaviour of ^{137}Cs appearing in cooling waters and effluents of nuclear installations and processing plants located near the sea. The relatively high radiotoxicity, long physical half-life and high fission yield of ^{137}Cs justify further investigation of its behaviour in aquatic environments. In this investigation the sampling of sea water, sediments and organisms in the Mediterranean Sea was undertaken. Cesium-137 determinations were carried out using an extremely low level Ge(Li) gamma spectrometry system specifically designed for studies of environmental marine radioactivity. The activity of ^{137}Cs on the surface of the sea was found to be 0.49+-0.17 pCi/l. Caesium-137 concentrations at depth profiles down to 1000 m below the surface show variations by a factor of ten (0.65-0.07), maximum concentrations being found at a depth of 100-300 m. Concentrations in a number of marine biota representing a marine food chain composed of benthic algae, invertebrates and fishes, were determined. With reference to the average ^{137}Cs content in the upper water layers of the sea, concentration factors for these organisms were calculated. In all the three taxonomic groups mentioned, values within the range 10-300 were found. Biological concentration factors for any particular radionuclide are independent of its content in the sea water within a wide range of concentrations.

26544 Some investigations into the behaviour of plutonium in the marine environment. Hetherington, J.A.; Jefferies, D.F.; Lovett, M.B. (Ministry of Agriculture, Fisheries and Food, Lowestoft (UK). Fisheries Radiobiological Lab.). pp 193-210 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

Plutonium and other transuranic elements are produced during the operation of magnox reactors, although they do not usually present any problems of waste management until the fuel reaches the reprocessing stage. At this stage one of the chief aims is to separate and recover the plutonium from the depleted uranium and the fission products, the incentive being the value of plutonium itself as a nuclear fuel particularly for the fast breeder reactors. For this reason the amounts of plutonium appearing in the low activity waste streams for discharge to the environment are usually small, and their radiological impact insignificant compared with that of the more abundant fission products. However, with the prospect of use of large quantities of plutonium in the fast reactors, considerable interest surrounds all aspects of the properties of plutonium, and in an attempt to give a fuller understanding of the behaviour of plutonium in the marine environment use has been made of the small amounts which have been discharged in recent years to the north-east Irish Sea from the fuel reprocessing plant at Windscale in Cumbria. Details of the amounts of ^{239}Pu and ^{240}Pu discharged to sea are given and the resultant measured concentrations of the isotopes in the water throughout the Irish Sea are shown. The distribution of plutonium in sea water is shown to follow the same basic pattern as the fissionproducts, details of which have been reported previously. By comparing the concentration gradients with distance from the point of discharge for plutonium and cesium, a value for the rate of loss of plutonium from the water to the other important compartment, namely the sediment, has been deduced.

26545 Uptake of cobalt-60 from sea water and from labelled food by the common shrimp Crangon crangon (L.). van Weers, A.W. (Stichting Reactor Centrum Nederland, Petten). pp 349-359 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The role of two different modes of uptake in the accumulation of ^{60}Co by the common shrimp (Crangon crangon (L.)) is the subject of the present study. The results show that accumulation of ^{60}Co from sea water is a slow process. The concentration factor for whole animals reached in one month was only about 13. Most of the activity accumulated from water appears to be associated with the exoskeleton. As a consequence, moulting has a pronounced effect on the uptake pattern of ^{60}Co and on the subsequent retention of the radionuclide by shrimps kept in non-radioactive sea water. After single feeding of shrimps with labelled mussel flesh, ^{60}Co is retained according to an exponential function with a short-lived and a long-lived component. The short-lived component has a mean biological half-life of 1.2 days and accounts for about 80% of the initial activity. About 20% of the initial activity is lost with a mean biological half-life of about 10 days. After repeated feeding of labelled mussel flesh the short-lived component in the ^{60}Co retention is virtually absent. Cobalt-60 taken up with food is localized mainly in the digestive gland and the concentration in the edible muscles from the abdomen is relatively small. It is concluded from the present study that direct uptake from sea water will play only a minor role in the accumulation of ^{60}Co in the internal organs of the shrimp. ^{60}Co released into the marine environment will be taken up by shrimps mainly from food. The results indicate a rapid turnover of ^{60}Co in shrimps.

26546 Plutonium isotopes in aquatic foodchains in the Baltic Sea. Miettinen, J.K.; Jaakkola, T.; Jaervinen, M. (Helsinki Univ. (Finland). Dept. of Radiochemistry). pp 147-152 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

A large number of nuclear power plants will be built along the Baltic coasts in the coming years. Some release of transuranium elements can be expected from this nuclear activity. Since the bays of the Baltic and especially the estuarine and coastal areas are very shallow, even small releases can cause noticeable local concentrations in coastal waters and sediments. It is important to determine the present levels of plutonium in the aquatic biota, before the power reactor activity really begins. For this purpose, plutonium isotopes in sea water, bottom sediment, algae, benthic fauna, and fish were and are being analysed and the results compared with those reported from other marine environments. The dried samples were ashed or wet-ashed and plutonium was separated by ion-exchange and electrodeposited on a platinum disc. The α-activity was determined using a surface barrier

semiconductor-detector. Study of coastal marine samples from the Gulf of Finland shows that fish (ruff, flounder, cod) contain 0.04-0.14 pCi (^{239}Pu+^{240}Pu)/kg fresh wt, blue mussel 0.6 pCi/kg fresh wt, brown alga 5 pCi/kg fresh wt and sediment 0.18 nCi/kg (1.68 mCi/km²) in the top centimetre. These values are comparable with those in the Great Lakes of the USA.

26547 Dose estimation and prediction of radiation effects on aquatic biota resulting from radioactive releases from the nuclear fuel cycle. Blaylock, B.G.; Witherspoon, J.P. (Oak Ridge National Lab., Tenn. (USA)). pp 377-392 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

Aquatic organisms are exposed to radionuclides released to the environment during various steps of the nuclear fuel cycle. Routine releases from these processes are limited in compliance with technical specifications and requirements of federal regulations. These regulations reflect I.C.R.P. recommendations, which are designed to provide an environment considered safe for man. It is generally accepted that aquatic organisms will not receive damaging external radiation doses in such environments; however, because of possible bioaccumulation of radionuclides there is concern that aquatic organisms might be adversely affected by internal doses. The objectives of this paper are: (1) to estimate the radiation dose received by aquatic biota from the different processes and determine the major dose-contributing radionuclides, and (2) to assess the impact of estimated doses on aquatic biota. Dose estimates are made by using radionuclide concentration measured in the liquid effluents of representative facilities. Where measurements of concentrations are not available, predicted radioactive releases to the aquatic environment are used for dose calculations. Although radioactive releases from reactors used to generate electrical energy have received the most attention, and are the best documented, this evaluation indicates the potential for a greater radiation dose to aquatic biota from the nuclear fuel supply facilities (i.e. mining and milling). The effects of chronic low-level radiation on aquatic organisms are discussed from somatic and genetic viewpoints.

26548 Partition of ruthenium-106 between the fresh water environment and crayfish. Berg, G.G.; Ginsberg, E. (Rochester Univ., N.Y. (USA). Dept. of Radiation Biology and Biophysics). *Health Phys.*; **30**: No. 4, 329-338(Apr 1976).

Crayfish of two species, Orconectes obscurus and Cambarus robustus, were identified in West Valley, New York, in streams contaminated with radioactive wastes. ^{106}Ru accounted for over 90% of the gamma radioactivity in specimens collected in 1972, and had higher concentrations in the crayfish than in fish from that site. Crayfish are suggested as indicator organisms for ^{106}Ru. In subsequent aquarium experiments, crayfish exposed to water labeled with inorganic complexes of ^{106}Ru concentrated the dissolved ruthenium an average of 9 x and accumulated 50% of the equilibrium body burden in approximately 10 hr, with the bulk of the isotope bound at the surface of the exoskeleton. If food was also exposed to the labeled water, uptake was faster and high concentrations were found in the digestive gland, which showed concentration factors in excess of 25 x. Releases were slower and bimodal, with approximately 10% of body burden remaining after 1 or 2 months in repeated changes of water. Data describe the partition of ^{106}Ru to colloidal aggregates and organically-bound sediments, and its availability for bioconcentration.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

26549 (INIS-mf—2022) **Investigation of hydrological and pollution problems with nuclear power plants. Frame of programme for 1975.** Nilsen, G. (Norsk Institutt for Vannforskning, Oslo). Dec 1974. 5p. (In Norwegian). INIS.

Following a general discussion of the scope of the problems to be studied by the Norsk Instititt for Vannforskning (NIVA) on behalf of Norges Vassdrags- og Elektrisitetsvesen, the framework of the continued investigations in 1975 is presented. Theoretical work will be based on literature studies and short visits, especially to Swedish institutions. Experimental work will cover the study of processes in coastal waters and fjords, of existing thermal discharges, of fouling and antifouling and of thermal influences in natural surroundings. Field investigations of prospective sites will also be carried out.

26550 (INIS-mf—2023) **Investigation of hydrological and pollution problems with nuclear power plants. Programme proposal for 1975.** Nilsen, G. (Norsk Institutt for Vannforskning, Oslo). Feb 1975. 12p. (In Norwegian). INIS.

The research programme for the Norsk Institutt for Vannforskning on behalf of Norges Vassdrags- og Elektrisitetsvesen for 1975 is presented in general terms. Studies of primary production of algae and plankton in the Droebak Sound in the Oslofjord will be continued as part of a new five-year programme. Decomposition processes and eutrofication will be studied in sediments from the inner Oslofjord in continuation of the work done in 1974. Sublethal and combined effects of local temperature variations in aquatic systems will also be studied, and a plant for the study of complex organism societies under field conditions with simulated thermal discharges is planned. The effect of discharge of large amounts of chlorinated and heated water in a limited recipient at Lista aluminium works will be studied with a view to model construction. The oxygen budget in deep water and process studies, studies of existing thermal discharges and fouling are also included. Expansion of field laboratory facilities and siting investigations are also planned.

26551 (INIS-mf—2024) **Investigation of hydrological and pollution problems with nuclear power plants. Results from the Oslofjord district for the period 1973—1974.** Nilsen, G. (Norsk Institutt for Vannforskning, Oslo). Dec 1974. 266p. (In Norwegian). INIS.

The results of a number of investigations designed to form a basis for the prediction of the effects of the thermal effluents from a nuclear power plant on the marine environment, which have been carried out in the Oslofjord district in the period 1973—1974 are reported. The effects of temperature increases on the predominantly arctic fauna of the deep water zones and the increase of green algae at the expense of brown algae form the main aspects. The decomposition in sediments and deep water, with evolution of hypoxic conditions is also discussed, as is hydrochemistry. Finally a brief evaluation of the suitability of the areas investigated as recipients of thermal discharges from nuclear power plants is presented.

26552 (INIS-mf—2025) **Investigation of hydrological and pollution problems with nuclear power plants. Hydrochemical investigations in the Oslofjord in 1973/1974.** Andreassen, E.; Magnusson, J.; Green, N. (Norsk Institutt for Vannforskning, Oslo). Dec 1974. 104p. (In Norwegian). INIS.

30 references.

The results of hydrochemical investigations of the Oslofjord, carried out in order to evaluate the effects of thermal discharges from a nuclear power plant on the marine environment, for the period 1973-1974, are presented. The analyses have concentrated on the nutrient salts of nitrogen and phosphorus, organic carbon and the heavy metals. Sampling has been carried out at 13 stations at depths down to 90m. An evaluation of various locations of cooling water intake and discharge is presented in tabular form.

26553 (ORO—4493-3) **Ecological study of the effects of power plants on benthic macroplant microcosms in subtropical and tropical estuaries. Annual progress report, 1975—1976.** Thorhaug, A. (Miami Univ., Fla. (USA)). May 1976. Contract E(40-1)-9493. 22p. Dep. NTIS $3.50.

The major focus was to understand the function of the seagrass community and to relate this to the impact of energy related activities, most importantly, thermal effluent. In addition, the increased turbidity, current, siltation and heavy metals were factors at the Turkey Point site. We attempted to delineate the effect of heat in the laboratory to determine the upper thermal tolerance of the seagrass. This was shown to be quite close to the combined effect of all the pollutants in the field for Thalassia and the macroalgae. This would indicate that temperature is a very fundamental factor in the growth and survival of the seagrass community.

26554 (PB—241941) **Winter-regime surface heat loss from heated streams. Research report.** Paily, P.P.; Macagno, E.O.; Kennedy, J.F. (Iowa Inst. of Hydraulic Research, Iowa City (USA)). Mar 1974. 154p. (IIHR—155). NTIS $6.25.

Sponsored in part by Iowa State Water Resources Research Inst., Ames.

Evaluation of the rate of surface heat exchange between the water and air has become very significant because of the need to determine the thermal response of streams to heat inputs. The different mechanisms of heat exchange that contribute to the total heat exchange were discussed and the various empirical formular to compute each of the components, as developed by various investigators, were presented and discussed. The suitability of each empirical formula was examined. The methods to linearize the total heat exchange rate were reviewed and a new linearized relation was proposed. General equations, suitable for winter-regime conditions, were presented to compute the coefficients of the linearized heat loss model. (GRA)

26555 (PB—242531) **Effect of atmospheric stability and wind direction on water temperature predictions for a thermally-loaded stream. Technical completion report.** DeWalle, D.R. (Pennsylvania State Univ., University Park (USA). Inst. for Research on Land and Water Resources). Jan 1975. Contract DI-14-31-0001-9032. 36p. NTIS $3.75.

A steady-state, one-dimensional equation was used to predict water temperatures in the West Branch Susquehanna River at a point 5.4-km downstream from a thermal discharge for 131 time intervals. Two methods were employed to integrate the equation to predict downstream water temperature: direct integration assuming a constant water surface heat exchange rate calculated from upstream water temperature and numerical integration with the heat exchange rate varying with temperature. Two equations were also used to compute evaporative heat exchange: the Jobson form of the familiar Lake Hefner equation derived under conditions of near-neutral stability and a Russian equation modified after Shulyakovskiy which included a correction for free convection. The direct integration method produced overestimates of heat loss and consequently underestimates of downstream water temperatures. (GRA)

26556 **Waste characterization studies for high-density raceway production of catfish: the Gallatin catfish project.** Gordon, J.A. (Tennessee Valley Authority, Chattanooga). pp 115-128 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P1.

Continuing the basic research in the production of edible catfish using heated condenser discharge water from the Gallatin Steam Plant incorporated into high-density raceway culture, researchers concluded that constant flow and continuous aeration did not function adequately. Flows had to be increased with growth of the fish in order to maintain the supply of dissolved oxygen to the fish. Predictive equations were developed for BOD, ammonia, and phosphate. Problems in either analytical or field procedures coupled with an inadequate understanding of solids production by catfish resulted in poor interpretation of the solids data. Low waste production required only settling as waste treatment and was exemplified by the excellent feed-to-meat ratios which were obtained. (PCS)

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 25919, 25992, 25995, 26498

REGULATIONS

REFER ALSO TO CITATION(S) 25918, 26496, 26498, 26502, 26510, 26516, 26521, 26523, 26562

26557 **Automatic car wash water recycle system.** Heinke, G.W. (Univ. of Toronto); Miyamoto, H.K.; Sernas, G.M.; Howard, D.E. pp 782-789 of In Proceedings of the 29th industrial waste conference. Bell, J.M. (ed.). Lafayette; Purdue University (1974).

From 29. industrial waste conference; Lafayette, Indiana, United States of America (USA) (7 May 1974).

See CONF-7405111—P2.

Studies were conducted to assess quality requiremets, and existing technology for installing water recycle systems for car wash installations. Preliminary designs for total recycle systems were tested and deemed non-feasible. Partial recycle was successful with water consumption per car from 10 to 25 gallons. (PCS)

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 26564

26558 (UCID—17178) **Man's impact on his global environment.** Knox, J.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1976. Contract W-7405-Eng-48. 8p. (CONF-760721—1). Dep. NTIS $3.50.

From Conference on the study of Democratic Institutions; Santa Barbara, California, United States of America (USA) (9 Jul 1976).

The experience and awareness growing from research activities leads to several important concerns for policy makers: there is a need to move towards a policy of conservation of our global air resources in its totality from earth's surface to stratosphere; the technical data base and level of understanding should be systematically improved for the rational implementation of standards for the whole atmosphere; the U.S. should establish a focal point for regional and global environmental assessments responsive to policymakers' needs and concerns, and interactive with the UN's Global Environmental Monitoring System; and the environmental consequences of increased U.S. dependence on coal should receive greater attention so that optimal choices between control technology, tall stacks, and synthetic fuels may be achieved with conservation of total air resources.

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 25911, 25912, 25913, 25940, 26462, 26463

26559 (IS-EMRRI—2) **Literature survey of dust explosions in grain handling facilities: causes and prevention.** Verkade, M.; Chiotti, P. (Iowa State Univ. of Science and Technology, Ames (USA)). 25 Mar 1976. 126p. Dep. NTIS $6.00.

Concern over recent fatalities and monetary losses suffered in grain industry dust explosions prompted a study of the causes and means of preventing them. A historical review of dust explosions in flour mills and other industries is presented. Grain elevator explosions are discussed with regard to causes, prevention, control, and enforcement of preventive measures. The following general characteristics of grain elevators are discussed: structural materials; physical layout; handling and conditioning the grain; types of grains handled; and personnel, economics and management. Other topics discussed are: requisite conditions for dust explosions; characterization of explosion hazards of dusts; dust control systems; venting; flame arrestors; separation devices; and general recommendations. (HLW)

26560 (LA-UR—76-1417) **ADP and brucellosis indemnity systems development.** Sanders, W.M.; Harlan, B.L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 16p. (CONF-760557—1). Dep. NTIS $3.50.

From Livestock conservation, incorporated; St. Paul, Minnesota, United States of America (USA) (17 May 1976).

Our initial study of the USDA/TAHC Brucellosis Indemnity Program in Texas has shown that both the efficiency and rate of claim payments can be increased by the application of present day computer technologies. Two main factors contribute to these increases: the number of discrepancies that are caused by poor penmanship, transposition of numbers, and other human errors can be monitored and minimized; and the documented information can be indexed, sorted, and searched faster, more efficiently, and without human error. The overall flow of documentation that is used to control the movement of infected or exposed animals through commerce should be studied. A new system should be designed that fully utilizes present day computer and electronic technologies.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 25940, 25977, 26184, 26559

26561 (BNWL—2000(Pt.4), pp 95-121) **Pacific Northwest regional assessment program.** Feb 1976.

In Pacific Northwest Laboratory annual report for 1975 to the ERDA Division of Biomedical and Environmental Research.

The Pacific Northwest (comprised of the states of Alaska, Idaho, Montana, Oregon, Washington and Wyoming) can by several measures be regarded as a national warehouse of fossil energy resources. This condition coupled with an evolving national policy stressing utilization of fossil fuels in the near term prior to development of more advanced technologies for energy supply, could result in the imposition of major changes in the region's environmental, socioeconomic and possibly health status. The objective of the Pacific Northwest Regional Assessment Program is to establish and exercise an integrated analytical assessment program for evaluation of these potential changes that may result from various energy development or conservation scenarios. After consideration of a variety of approaches to integrated assessment at a regional level, Pacific Northwest Laboratories (PNL) has concluded that dynamic simulation techniques provide the best available approach to evaluating the issues pertinent to the Northwest.

As a result, the PNW Regional Assessment Program has been structured in a framework involving ten sectors. Each of these sectors involve their own submodels that receive information either from outside the model as exogenous inputs or from other sector submodels.

26562 (CONF-760826—5) **Controlling the radiological impact in the nuclear fuel cycle: a cost/benefit analysis.** Blanco, R.E. (Oak Ridge National Lab., Tenn. (USA)). 1976. Contract W-7405-ENG-26. 64p. Dep. NTIS $4.50.

From American Chemical Society meeting; San Francisco, California, United States of America (USA) (29 Aug 1976).

Methods that are used to control the radiological impact of the nuclear fuel cycle are discussed. This control is exercised through the application of a series of Federal laws and regulations that are used as the basis for licensing nuclear facilities. These licenses contain technical specifications which define the limits for the release of radioactive materials. The control is exercised more directly in a technical sense by the use of radwaste treatment equipment at the nuclear facilities to limit the release of radioactive materials. The first part of this paper contains a summary of the principal Federal laws and regulations that apply to nuclear fuel cycle facilities and a description of how they are applied in licensing procedures. A detailed discussion is presented of the amounts of radioactive materials that may be released from licensed facilities, and the radiological doses that individuals and populations surrounding these facilities would receive from these releases. These doses are then compared with the radiological doses received from natural background radiation to put them in perspective. Cost/benefit engineering surveys which are being made to determine the cost (in dollars) and the effectiveness of radwaste systems for decreasing the release of radioactive materials from model fuel cycle facilities, and to determine the benefits in terms of reduction in dose commitment to individuals and populations in surrounding areas are described. (CH)

26563 **Radiological effects of a nuclear power plant on a river system, as demonstrated by the Gundremmingen BWR on the Danube.** Herrmann, H.; Ruf, M.; Huebel, K.; Luensmann, W. (Bayerische Biologische Versuchsanstalt, Muenchen (F.R. Germany)). pp 461-470 of In Impacts of nuclear releases into the aquatic environment. Proceedings of an international symposium on radiological impacts of releases from nuclear facilities into aquatic environments held by the IAEA at Otaniemi, Finland, 30 June to 4 July 1975. Vienna; IAEA (1975).

From International symposium on radiological impacts of releases from nuclear facilities into aquatic environments; Otaniemi, Finland (30 Jun 1975).

The Gundremmingen Nuclear Power Plant (boiling water reactor, 237 MW(e)), on the Upper Danube, has been in operation since 1967. Radiological data have been collected throughout its period of operation. The behaviour of the radioactive waste products in the ecological system of the Upper Danube (water, sediments, suspended solids, water-plants, fish) has been analyzed in connection with environmental contamination, the uptake capacity of the Danube, and the possible pathways to man. As a result of the investigations, it seems possible to build further nuclear power plants on the Danube, if their rates of release of radioactivity are similar to those at Gundremmingen.

ENVIRONMENTAL IMPACT STATEMENTS

26564 (ERDA—1536(DRAFT)) **Environmental statement: waste management operations.** (Idaho National Engineering Lab., Idaho Falls (USA)). Jun 1976. vp.

The Idaho National Engineering Laboratory (INEL) was established in 1949 as an area where nuclear reactors, support plants, and equipment could be constructed, tested, and operated. In the operation of the nuclear facilities that have been sited at the INEL during the last 25 years, radioactive and non-radioactive wastes have been generated. There have been continuous and evolving programs for waste management and environmental assessment, which are described in this document. This statement reassesses the environmental impact of the INEL Waste Management Operations Program to assure that present actions minimize adverse environmental consequences and to identify those environmental consequences that may not have been fully evaluated at the outset or at each stage of the program. The statement will serve as a base for evaluating the environmental impact of future actions in relation to the existing environment at the INEL. Waste generated by research, development, and other programs and activities at the INEL is described in detail. The operation of each facility is described and evaluated only as it relates to waste generation and management. Impacts, alternatives, costs and/or benefits of the operation of research and development programs and facilities are not covered since this is outside the scope of this statement.

BIOMEDICAL SCIENCES, BASIC STUDIES

REFER ALSO TO CITATION(S) 26173

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 26197, 26632

26565 (CONF-750136—1) **Structure-activity correlations for phenoxyacetic acids and indoleacetic acids used for plant growth regulations.** Block, A.McB.; Clements, R.G. (Puerto Rico Nuclear Center, Mayaguez). 1975. 14p. Dep. NTIS $4.00.

From Sanibel quantum biology symposium; Sanibel Island, Ft. Myers, Florida, USA (15 Jan 1975).

Experiments on substituted indole-3-acetic acids and halogenated indoles have led to the suggestion that fractional positive charge development on the -NH group of the indole ring at a fortuitous distance (5.5A) from the carboxylic acid function is requisite for plant auxin activity exhibited by indoleacetic acids. Calculations using self-consistent field (SCF) molecular orbital (MO) theory with complete neglect of differential overlap (CNDO) were carried out on a series of halo-substituted indoleacetic acids and on a series of substituted phenoxyacetic acids. No net positive charge development calculated for the N-H group in the substituted indoleacetic acids gave the observed order of auxin activity. No development of positive charge in the II-p/sub z/ system calculated for N was in any way comparable to the observed auxin activity increase. However, the energies of the lowest unoccupied molecular orbitals (LUMO's) decreased nearly linearly with increasing auxin activity. Twelve substituted phenoxyacetic acids, also treated, showed a correlation between the LUMO energies and the square of the LUMO coefficients at the ortho position and plant auxin activity when the lipophilicity of the molecules in the series was taken into account. While no fractional positive charge development at the suggested distance from the carboxylic acid group in either series emerged from the calculations, there are clear indications of an electron accepting role for auxin activity of both series. (auth)

26566 (CONF-760820—1) **tRNAs and aminoacyl-tRNA synthetases of Euglena chloroplasts.** Barnett, W.E.; Schwartzbach, S.D.; Hecker, L.I. (Oak Ridge National Lab., Tenn. (USA)). 1976. 8p. Dep. NTIS $3.50.

From Conference on genetics and biogenesis of chloroplasts and mitochondria; Munich, German, Federal Republic of (F.R. Germany) (2 Aug 1976).

The following topics are discussed: identification and regulation of tRNAs and synthetases; transcriptional and translational origin of chloroplastic synthetases; transcriptional origin of chloroplastic tRNAs; and primary sequence studies of chloroplastic tRNAs. (HLW)

26567 (LBL—4717) **Relipidation of human plasma apolipoproteins with phospholipids.** Verdery, R.B. III. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1975. Contract W-7405-ENG-48. 226p. Dep. NTIS $8.00.

Thesis.

Relipidation of three major apolipoproteins with two phospholipids, lecithin, and lysolecithin were studied. Preparative ultracentrifugation, electron microscopy, and gradient gel electrophoresis were used to characterize the complexes formed. Circular dichroism and fluorescence were used to gain insight into the effect of lysolecithin on the conformation of these apolipoproteins. Lecithin apparently relipidated A-I during incubation without sonication, forming two different complexes at all ratios of A-I and lecithin. One complex had a low lipid:protein ratio and the other complex had a high lipid:protein ratio. The complex with the low lipid:protein ratio apparently had a molecular weight less than 120,000; the other had a high molecular weight, greater than 900,000. Electron microscopy, however, indicated that various classes of complexes with different sizes were formed in each mixture of lecithin and A-I. In the presence of lysolecithin, A-I was relipidated with lecithin in a markedly different way than in the absence of lysolecithin. Based on the results of preparative ultracentrifugation it appeared as if only one class of complexes was formed during incubation of mixtures of lecithin, lysolecithin, and A-I. In no mixture did there appear to be distinct classes with different densities. By electron microscopy, particles of specific shapes could be discerned in specificmixtures of lecithin, lysolecithin, and A-I. These results were summarized by means of a ternary phase diagram showing the relation of mixture composition

to the shapes of the mixed micelles seen in a mixture with a particular ratio lecithin:lysolecithin:A-I. An hypothesis to explain the effect of lysolecithin on the relipidation of A-I was developed.

26568 (ORO—2690-16) **Research proposal and annual report No. 16. Part B. Technical progress, September 1, 1975—August 31, 1976.** (Florida State Univ., Tallahassee (USA). Inst. of Molecular Biophysics). 1 Jun 1976. Contract AT(40-1)-2690. 67p. Dep. NTIS $4.50.

Progress is reported on the following research projects: RNA synthesis in yeast; regulation of nitrogen metabolism; biological toxicity of intracellular radioisotope decay; the mechanism of energy conversion in chloroplasts; promoting vibrations in spin-orbital coupling in vibrationally deficient molecules; electronic excitation and hydrogen bonding; macromolecular biophysics; the synthesis and maturation of RNA; electronic response properties of biomolecular systems; chromosome structure and function and chromosome damage; DNA replication and chromosome structure; and influence of phospholipids on the dynamic properties of rhodopsin. (HLW)

26569 (ORNL-tr—4110) **Carcinogens in nutrient fats and oils.** Borneff, J.; Fabian, B. Translated by R.G. Mansfield from *Arch. Hyg. Bakteriol.*; **150**: No. 32, 485-511(1966). 27p. Dep. NTIS $4.00.

Cancer producing polycyclic aromatics were found in vegetable cooking fats, including 3,4-benzpyrene in concentrations of 5—20 μg/kg. Controlled laboratory heating reduced the concentrations by approximately 70 percent. This reduction was missing in fats which had been used in hotel kitchens for a long time, which can be explained by the development of a compound or its elution out of the prepared plant foods, e.g., potatoes. In pork fat the concentration of cancer producing compounds lies below the detectable level; only pyrene and fluoranthene were found. The daily uptake of carcinogenic polycyclic aromatics with drinking water, plants, fats and vegetables is in the ratio of 1:10:100. The results are discussed.

26570 (ERDA-tr—146, pp 128-131) **Study of the degradation products of DNP from the rat thymus by methods of gel filtration on sepharose 4B and ultra-centrifugation in a sucrose gradient.** Vodolazskaya, N.A.; Ermolaeva, N.V. 1975. Translated from Radiobiologiya; 15: No. 5, 738-741(1975).

In Radiobiology.

For an understanding of the biological significance of the process of decomposition of DNP, arising in the hematogenic tissues 2 hrs after irradiation, we made a comparative study of the physicochemical properties of the products of degradation of DNP, accumulated in the rat thymus in response to injurious influences, differing in initial mechanism of action, namely, irradiation, administration of hydrocortisone or a radiomimetic, degranol. The use of the method of ultracentrifugation in a sucrose concentration gradient after preliminary gel filtration of the investigated material in this work permitted some conclusions to be drawn on the composition of the DNP fragments isolated 6 hrs after the influence, i.e., in the period of their maximum accumulation.

26571 **Properties of rooster serum high density lipoproteins.** Kruski, A.W.; Scanu, A.M. (Univ. of Chicago). *Biochim. Biophys. Acta;* **409**: 26-38(1975).

The physical and chemical properties of normolipemic rooster serum high density lipoproteins (HDL) were determined and compared with human HDL. Rooster HDL was found to be composed of essentially one class of particles, as determined by flotational analysis at d 1.21 g/ml in the analytical ultracentrifuge. On a weight-percentage basis, it contained 44, 29, 16, 5 and 6 percent protein, phospholipid, cholesteryl ester, cholesterol, and triacylglycerol, respectively. This distribution resembled that of human HDL_2 more closely than that of HDL_3. On the other hand, the physical parameters of rooster HDL resembled those of human HDL_3. The sedimentation coefficient, diffusion coefficient, molecular weight, partial specific volume and the anhydrous frictional ratio for rooster HDL were 3.99 S, $4.36.10^{-7}cm^2.s^{-2}$, $1.73.10^5$, 0.868 ml/g, and 1.24, respectively. However, the circular dichroic spectra of rooster HDL indicated an α-helical content 20 percent greater than that in human HDL. The lipid composition resembled that of human HDL except for a relatively higher content of stearic acid. The HDL protein gave several bands by polyacrylamide gel electrophoresis. The main component, representing almost 90 percent of the total protein, had a molecular weight of about 26,000, an amino acid composition and an electrophoretic mobility similar to those of human apolipoprotein A-I. A component of mol. wt 15,000 and a group of fast-migrating peptides, resembling the human apo C peptides, were also found. It is concluded that the structure of rooster HDL, although showing similarities to human HDL, can be distinguished from the latter by some physical parameters, but particularly by its polypeptide distribution.

26572 **Measurement of thymine dimers in DNA by thin-layer chromatography. II. The use of one-dimensional systems.** Cook, K.H.; Friedberg, E.C. (Stanford Univ., CA). *Anal. Biochem.*; **73**: No. 2, 411-418(Jun 1976).

A number of chromatographic solvents and thin-layer chromatographic matrices were tested for their effectiveness in separating thymine dimers from thymine by one-dimensional chromatography. One combination, viz., water-saturated ethylacetate:n-propanol on silica gel thin layers was found to be particularly useful.

26573 **Temperature effect on affinity chromatography of two lectins from the seeds of Ricinus communis.** Hsu, H.W.; Davis, D.S.; Wei, C.H.; Yang, W.K. (Univ. of Tennessee, Knoxville). *Anal. Biochem.*; **73**: No. 2, 513-521(Jun 1976).

Specific adsorption capacity of Sepharose 4B in affinity chromatography for two purified galactose-binding lectins, designated as III/sub L/ and III/sub H/, from the seed of Ricinus communis (castor bean) was measured from 7 to 24°C. The adsorption coefficients for these two protein fractions as a function of temperature were also obtained. It was found that there is a characteristic transition of adsorption coefficient at 18°C for both lectins. Adsorption coefficients between Sepharose 4B and these two lectins were also expressed in terms of ΔG, ΔH, and ΔS. It is suggested that the difference in the temperature dependence of the binding energy of these two lectins may be used for their separation at selected temperature.

26574 **Comparision of Canavanyl-envelope proteins to normal envelope proteins.** Allen, T.D.; Rogers, P. (Univ. of Minnesota, Minneapolis). *J. Bacteriol.*; **127**: No. 1, 674-676(Jul 1976).

Electrophoretic analysis showed arginine- and canavanine-containing envelope proteins to be qualitatively the same. Quantitative differences may be due to rapid degradation of some canavanine-containing envelope proteins.

26575 **Model for cytochrome oxidase.** Palmer, G. (Rice Univ., Houston, TX); Babcock, G.T.; Vickery, L.E. *Proc. Natl. Acad. Sci. U.S.A.*; **73**: No. 7, 2206-2210(Jul 1976).

A model is proposed for the active center of cytochrome c oxidase (ferrocytochrome c:oxygen oxidoreductase, EC 1.9.3.1) in which cytochrome a is a low-spin ferrihemoprotein and cytochrome a_3 is a high-spin ferrihemoprotein antiferromagnetically coupled to one of the two Cu^{2+} ions present in the enzyme. It is further proposed that reduction is accompanied by a conformational change in the enzyme thus exposing the sixth coordination site of cytochrome a_3 to ligands. With this model it is possible to account for a variety of outstanding observations including the results of magnetic circular dichroism, Mossbauer, and electron paramagnetic resonance spectroscopies, as well as magnetic susceptibility measurements.

CYTOLOGY

REFER ALSO TO CITATION(S) 26378

26576 **Ellipsoidal cell flow system.** Salzman, G.C.; Mullaney, P.F. (to Energy Research and Development Administration). US Patent 3,946,239. 23 Mar 1976. Filed date 24 Jan 1975. 6p.

PAT-APPL-544,026.

The disclosure relates to a system incorporating an ellipsoidal flow chamber having light reflective walls for low level light detection in practicing cellular analysis. The system increases signal-to-noise ratio by a factor of ten over prior art systems. In operation, laser light passes through the primary focus of the ellipsoid. A controlled flow of cells simultaneously passes through this focus so that the laser light impinges on the cells and is modulated by the cells. The reflective walls of the ellipsoid reflect the cell-modulated light to the secondary focus of the ellipsoid. A tapered light guide at the secondary focus picks up a substantial portion of modulated reflective light and directs it onto a light detector to produce a signal. The signal is processed to obtain the intensity distribution of the modulated light and hence sought after characteristics of the cells. In addition, cells may be dyed so as to fluoresce in response to the laser light and their fluorescence may be processed as cell-modulated light above described. A light discriminating filter would be used to distinguish reflected modulated laser light from reflected fluorescent light.

26577 **Effect of serum on the growth of Balb 3T3 A31 mouse fibroblasts and an SV40-transformed derivative.** Bartholomew, J.C.; Yokota, H.; Ross, P. (Univ. of California, Berkeley). *J. Cell. Physiol.*; **88**: No. 3, 277-286(Jul 1976).

The effect of serum on the growth properties of non-transformed Balb 3T3 A31 and SV40-transformed Balb 3T3 A31 was

studied. The concentration of serum in the growth medium of non-transformed cells had little effect on the initial population doubling time, but did regulate the cell density at which the population became quiescent in G_1. The doubling time of transformed cells, however, was increased significantly as the concentration of serum was decreased below 4 percent. This effect on the growth of transformed cells was seen at serum concentrations so low that non-transformed cells did not complete one population doubling. Flow microfluorometric analysis of these populations indicated that the primary effect of different serum concentrations on the non-transformed cells was to modulate the average residence time in G_1, whereas, all the cell cycle phases of the transformed cells were affected by serum. At saturation densities, the non-transformed cells became quiescent in G_1, but the transformed cells still traversed the cell cycle and their saturation density appeared to be a balance between cell production and cell death occurring primarily in the G_1 phase of the cell cycle.

GENETICS

REFER ALSO TO CITATION(S) 26589

26578 Similarity in properties and mapping of three rec mutants of Haemophilus influenzae. Kooistra, J.; Setlow, J.K. (Brookhaven National Lab., Upton, NY). *J. Bacteriol.*; **127**: No. 1, 327-333(Jul 1976).

Three Rec$^-$ mutants of Haemophilus influenzae have been studied with respect to their transformability, ultraviolet and mitomycin C sensitivities, spontaneous and ultraviolet-induced deoxyribonucleic acid breakdown, inducibility of lysogens, and the linkage of the three mutations to a streptomycin resistance marker. The data indicate that the three mutations cause the same phenotypic changes, and that they are all on the same gene. Transformability of the mutants is different when two different media are used for competence development, although transformability with the two competence methods is not different in a Rec$^-$ strain that is mutant at another gene.

METABOLISM

REFER ALSO TO CITATION(S) 25349, 25350, 25351, 25352, 25353, 25354, 25355, 25356, 25357, 25358, 25359, 25360, 25361, 25362, 26470, 26484, 26486, 26487, 26488, 26489, 26491, 26492, 26493, 26568, 26619

26579 (CONF-760632—2) **Zinc—cadmium interrelationships and the kinetics of cadmium transport in a biological system.** Shank, K.E.; Vetter, R.J.; Ziemer, P.L. (Oak Ridge National Lab., Tenn. (USA); Purdue Univ., Lafayette, Ind. (USA)). 1976. 13p. Dep. NTIS $3.50.

From 10. annual conference on trace substances in environmental health; Columbia, Missouri, United States of America (USA) (8 Jun 1976).

The research was undertaken to analyze the uptake and distribution of cadmium in the mouse following repeated dosings and to observe how the simultaneous administration of zinc affected cadmium retention. Mice were given either one, two, or three administrations of cadmium or cadmium plus zinc, and animals were sacrificed at specific times following each injection. It was observed that the zinc had little effect on the retention of cadmium in the samples analyzed. A linear mathematical model was derived that described the transport of cadmium in the mouse. The model was a mammillary compartmental model, with the compartments corresponding to selected organs and tissues. The injections behaved independently from each other; therefore, in the model the same rate constants were used for each of the multiple dosings. The linear mammillary model was able to predict the observed laboratory values in the present investigation, and the model was also shown to be able to predict the retention of cadmium in other species.

26580 (LSU-SG—73-01, pp 25-32) **Hydrocarbon utilization by Cladosporium resinae.** Cooney, J.J.; Walker, J.D. (Univ. of Dayton, OH). 1973.

In Microbial degradation of oil pollutants.

Each of two strains of C. resinae, a filamentous fungus, was tested for ability to grow on 55 individual hydrocarbons as the sole source of organic carbon with NH_4NO_3 as the nitrogen source. Compounds which supported growth included alkanoic alcohols and acids, n-alkenes, and some cyclic and aromatic compounds. The total cell lipid and cellular hydrocarbon content were 2 to 3 times greater in hydrocarbon-grown C. resinae than in cells cultured on glucose or on glutamic acid. C. resinae resembles a number of hydrocarbon-using bacteria and yeasts in that it grows slowly on hydrocarbons. (HLW)

26581 (LSU-SG—73-01, pp 33-38) **Microbial degradation of aromatic hydrocarbons.** Gibson, D.T.; Yeh, W.K. (Univ. of Texas, Austin). 1973.

In Microbial degradation of oil pollutants.

Bacteria capable of growth on benzene, toluene, ethylbenzene, napthalene and biphenyl were isolated from soil. Mutagenesis led to the isolation of different bacterial strains that will accumulate the initial products of hydrocarbon oxidation. The results obtained suggest that cis-hydroxylation is a common reaction in the microbial oxidation of aromatic hydrocarbons.

26582 (LSU-SG—73-01, pp 39-45) **Microbial degradation of oil and hydrocarbons in continuous culture.** Pritchard, P.H.; Starr, T.J. (State Univ. of New York, Brockport). 1973.

In Microbial degradation of oil pollutants.

Preliminary results are presented which support the proposed use of continuous culture techniques to study oil degradation. Experiments with both pure and mixed bacterial populations have shown that slow but significant degradation rates can be obtained with an undisturbed, two-phase (water-hydrocarbon) system.

26583 (LSU-SG—73-01, pp 47-65) **Utilization of crude oil hydrocarbons by mixed cultures of marine bacteria.** Kator, H. (Univ. of Texas, Port Aransas). 1973.

In Microbial degradation of oil pollutants.

Mixed cultures of petroleum-utilizing marine bacteria were isolated from a wide variety of oil-contaminated marine sediments and waters. N-paraffin degradation patterns were similar for different major crude oils. However, the rates of total n-paraffin utilization were significantly larger with Louisiana crude oil. Graphs are presented to show quantitative changes in n-paraffin composition in various crude oils incubated with mixed bacterial cultures. Normal and branched paraffins were preferentially utilized and utilization rates were inversely related to chain length. (HLW)

26584 (LSU-SG—73-01, pp 67-79) **Microbial decomposition patterns using crude oil.** Mechalas, B.J.; Meyers, T.J.; Kolpack, R.L. (Univ. of Southern California, Los Angeles). 1973.

In Microbial degradation of oil pollutants.

A mixed culture of microorganisms, acclimated to decomposition of crude oil, was used in a series of incubation experiments to determine the sequence of microbial degradation in a Santa Barbara, California, crude oil. The molecular weight distribution of the crude oil was C_1 to C_{10}, 29 percent; C_{10} to C_{20}, 52 percent; and greater than C_{20}, 19 percent. At least 15 percent, by weight, of this oil was composed of n-alkanes, or straight chain paraffins. Gas chromatograms of the stock crude oil were characterized by (in order of prominence) an envelope of n-paraffins, six highly resolved isoprenoid hydrocarbons, and more than a hundred smaller peaks that were partially resolved above the base envelope. Microbial degradation of the crude oil is initially characterized by a rapid disappearance of the n-paraffin envelope. This degradation starts with the low molecular weight components and progresses toward the higher molecular weight compounds. The isoprenoids are also progressively reduced simultaneously with the reduction of the paraffins. In addition, the base envelope and fine fingerprint region subsequently undergo degradation and the base envelope becomes progressively skewed toward the higher molecular weight end of the chromatogram. Biodegradation of the Santa Barbara crude oil by a mixed microbial population was initiated simultaneously on all components, but the sequential patterns of decomposition were affected by rate differences. Chromatograms of naturally weathered oils collected from southern California beaches are remarkably similar to chromatograms of oil samples which have undergone extensive microbial decomposition in the laboratory.

26585 (LSU-SG—73-01, pp 237-243) **Estuarine microbes and organochlorine pesticides (a brief review).** Bourquin, A.W. (Gulf Breeze Environmental Research Lab., FL). 1973.

In Microbial degradation of oil pollutants.

Microbial degradation of organochlorine pesticides in the estuarine and oceanic environments is reviewed. Some topics discussed are similarity of soil and water microorganisms in their environmental relationships and microbial associations; degradation of pesticides by aquatic and soil microorganisms; estuarine sediments as a reservoir for pesticides transported by rivers; microbial metabolic transformations of DDT, dieldrin, aldrin, and endrin in marine water, bottom sediments, and surface films; co-metabolism of pesticides by microorganisms; synergism within the microbial ecosystem; surface slicks on seas caused by organic detritus from estuaries; and pathways of microbial attack on

chlorinated hydrocarbons. A table is presented to show genera of bacteria, fungi, yeasts, and algae, the pesticides metabolized by each, and literature references. (HLW)

26586 (LSU-SG—73-01, pp 245-258) **Measurement of baseline levels of enteric bacterial activity in river water.** Hendricks, C.W. (Univ. of Georgia, Athens). 1973.

In Microbial degradation of oil pollutants.

This investigation indicates that natural populations and selected laboratory strains of enteric bacteria, including pathogens, have the capacity to metabolize substrates present in the Oconee River, including autoclaved river water. These organisms, however, lacked the ability to increase in numbers in continuous culture with river water and suspended detritus recovered above a secondary sewage treatment facility, but demonstrated positive growth rates with substrates recovered below the plant. Data also showed that the sands and clays forming the stream bottom had the capacity to sorb substrates from the overlayering water, and that sediment eluates stimulated the respiration rate of bacteria. This suggests that the stream bottom can provide a suitable environment for the growth of bacteria and perhaps controls basal nutrient concentration in the water itself.

26587 (ORNL-tr—4161) **Stable and fluctuating temperature. I. Comparative study of their effects on the development of Planarians.** Pattee, E. 1974. Translation by M. Gerrard of French paper. (CONF-7409157—1). 10p. Dep. NTIS $3.50.

From Conference of the International Society of Theoretical and Applied Limnology; Winnipeg, Canada (Sep 1974).

The temperatures were a constant 10°C level on the one hand, and a 24 h pattern varying rhythmically between 5 and 15°C on the other hand. The Triclads were the two closely related limnophilic species Polycelis nigra and P. tenuis. The effect of the two temperature regimes depends on the species considered. When compared with the 10°C constant level, fluctuations accelerated the development in P. nigra. In P. tenuis the duration of egg development remained unchanged but the maturation and generation times were significantly lengthened by these fluctuations. Considering cocoon development, the computation of expected times determined from the hourly proportion of development occurring at 5, 10 and 15°C constant levels gives a better approximation of times observed under fluctuating conditions than does the consideration of the development time for the sole mean level of 10°C. If confirmed by new experiments under different temperature regimes, these results ought to provide a contribution to the mutual interpretation of laboratory and field data on the effects of temperature.

26588 Transport of glucose and glycine in Schizosaccharomyces pombe during the cell cycle. Kubitschek, H.E.; Claymen, R.V. (Argonne National Lab., IL). *J. Bacteriol.;* **127**: No. 1, 109-113(Jul 1976).

Cell growth and uptake of glucose and glycine during the cell cycle were studied in synchronous cultures of Schizosaccharomyces pombe. Rates of accumulation of glucose and glycine were constant during most of the cell cycle, implying a constant rate of cell mass increase. Rates of uptake of glycine appeared to double at an average cell age of 0.9 generations.

26589 SAMase gene of bacteriophage T3 is responsible for overcoming host restriction. Studier, F.W.; Movva, N.R. (Brookhaven National Lab., Upton, NY). *J. Virol.;* **19**: No. 1, 136-145(Jul 1976).

Deletion and point mutants of T3 have been isolated and used to show that the early region of T3 DNA is organized in the same way as that of T7 DNA. Homologous early RNAs and proteins of the two phages have been identified by electrophoresis on polyacrylamide gels in the presence of sodium dodecyl sulfate. Both phages have five early mRNA's, numbered 0.3, 0.7, 1, 1.1, and 1.3 from left to right, although no T3 protein that corresponds to the 1.1 protein of T7 has yet been identified. In general, corresponding early RNAs and proteins of the two phages migrate differently on gels, indicating that they differ in molecular weight and/or conformation. In both T7 and T3, gene 0.3 is responsible for overcoming the DNA restriction system of the host, gene 0.7 specifies a protein kinase, gene 1 specifies a phage-specific RNA polymerase, and gene 1.3 specifies a polynucleotide ligase. The 0.3 protein of T3 is responsible for the S-adenosylmethionine cleaving activity (SAMase) induced after T3 (but not T7) infection. However, cleaving of S-adenosylmethionine does not appear to be the primary mechanism by which T3 overcomes host restriction, since at least one mutant of T3 has lost the SAMase activity without losing the ability to overcome host restriction.

TRACER TECHNIQUES

26590 Applications of stable isotopes of ^{2}H, ^{13}C and ^{15}N to clinical problems. Experience of a collaborative program at Argonne National Laboratory. Klein, P.D.; Szczepanik, P.A.; Hachey, D.L. (Argonne National Lab., Evanston, Ill. (USA)). *Proc. Jpn. Conf. Radioisot.;* No. 11, 161-170(Aug 1974).

From 11. Japan conference on radioisotopes; Tokyo, Japan (13 Nov 1973).

The function of the Argonne Program is to provide synthetic, analytical instrumental capability in a core facility for the clinical investigator who needs to use ^{2}H, ^{13}C, or ^{15}N labelled compounds for metabolic or clinical research on pregnant women, newborn infants, young children, or for mass screening. To carry out such application development, there were six stages which were recurrent steps in every application. Five fundamental strategies should be adopted to establish the use of stable isotopes in clinical work. The instrument required for measurements was a combined gas chromatograph-mass spectrometer, and its use was schematically illustrated. Some of the successful experiences with compounds labelled by stable isotopes, such as deuterium labelled chenodeoxycholic acid, and respective ^{13}C and ^{15}N-labelled glycine were described. Deutrium labelled bile acid enabled easy and safe determination of the size of the bile acid pool and the replacement rate, providing clearer diagnoses for cholestatic liver disease and gallstones. ^{13}C and ^{15}N labelled compounds were used in clinical studies, of children with genetic disorders of amino acid metabolism, i.e., non ketotic hyperflycinemia, B_{12}-responsive methyl malonic acidemia, and Lesch-Nyhan syndrome. ^{15}N-labelled glycine was also studied in a child with Lesch-Nyhan syndrome.

MEDICINE

REFER ALSO TO CITATION(S) 26378

26591 (UCRL-Trans—10748) **Arrangement for obtaining values corresponding to the quantities of particles of differing volume that are contained in a test liquid.** Thom, R. May 1974. Translated from German Patent 1,955,094. 9p. Dep. NTIS $3.50.

The invention relates to an arrangement for obtaining values that correspond to the quantities of particles having various volumes contained in a test liquid, consisting of (1) two vessels connected by a capillary and arranged in relation to each other or designed in such a way that electrolyte liquid continuously flows from one vessel into the other, (2) an electrode system connected to a DC voltage source and introduced into the electrolyte in such a way that the migration of ions caused by the voltage on the electrodes takes place through the capillary and (3) a measuring device that determines the magnitudes of the brief changes in the current between the electrodes that occur when particles pass through the capillary, and stores the number of changes in current separately according to size ranges. The device has applications in medical science. (auth)

26592 Ceruloplasmin levels in sera from human patients with osteosarcoma. Shifrine, M.; Fisher, G.L. (Univ. of California, Davis). *Cancer;* **38**: No. 1, 244-248(Jul 1976).

Ceruloplasmin (Cp) levels in sera of osteosarcoma patients, women on chemical contraceptives, and normal individuals were determined by radial immunodiffusion (RID) and rocket electroimmunophoresis (REP) techniques; serum copper levels (SCL) were determined by atomic absorption spectroscopy. Ratios of SCL/Cp were constant in all groups tested, indicating that the ratio of bound to unbound copper in the serum is maintained relative to normal levels both in osteosarcoma patients and in women receiving chemical contraceptives. There was a highly significant increase over normal levels in Cp concentration in sera from patients with osteosarcoma and from women on chemical contraceptives, in agreement with our previous data on SCL. Either RID or REP can be used to measure serum Cp. The latter method appears to be faster and more sensitive, whereas the former is easier to perform. It appears that the determination of serum Cp in osteosarcoma patients may be of value in differential diagnosis of the disease in selected patients, and in evaluation of the efficacy of therapy.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 26258, 26590

26593 Manifestations of hypertrophic pulmonary osteoarthropathy in patients with carcinoma of the lung. Demonstration by /sup 99m/Tc-pyrophosphate bone scans. Freeman, M.H.; Tonkin, A.K. (Univ. of Florida, Gainesville). *Radiology;* **120**: No. 2, 363-366(Aug 1976).

Two patients with carcinoma of the lung were studied with /sup 99m/Tc-stannous pyrophosphate. Resolution of scintigraphic activity was observed postoperatively in one patient, while the second patient showed an asymmetric pattern of radionuclide uptake and radiographic changes as well as clinical findings of hypertrophic pulmonary osteoarthropathy.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 26011

MORPHOLOGY

REFER ALSO TO CITATION(S) 26433

PATHOLOGY

26594 (CONF-760470—1) **Analysis of published experiments on effects of trace element administration on life tables of experimental animals.** Sacher, G.A. (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-eng-38. 18p. Dep. NTIS $3.50.

From Biomedical role of trace elements in aging; St. Petersburg, Florida, United States of America (USA) (28 Apr 1976).

This paper reviews a body of published research on the effects of continuous administration of low levels of trace elements on the survival and disease incidence of mice and rats. There is a large literature on the pathological and pathophysiological effects of various trace elements, but the only systematic quantitative analysis of the life table effects of a number of trace metals is the long series of investigations carried out by the late Dr. Henry A. Schroeder and his associates at the Dartmouth Medical School. This review examines the data compiled by Schroeder et al., with the specific purpose of discovering how the various trace elements affect the parameters of the aging process. Two circumstances combine to limit the value of the data for these estimations. The first is that the purposes of the Schroeder program led to the selection of exposure levels that in the majority of trials had no significant effects. The second limitation is that the published papers do not, with a few exceptions, give the distribution of ages at death for tumors or other disease categories. The actuarial effects identified here must be considered to be provisional because of the limited amount of statistical material available for analysis, but the findings are intriguing, and would justify not only a more thorough reexamination of the Schroeder data, but also further planned research on the apparent antagonism between life shortening and tumor induction that is seen in the Schroeder data.

26595 (COO—910-41) **Bovine lymphocytic leukemia: studies of etiology, pathogenesis, and mode of transmission. Progress report No. 16, July 1975—July 1976.** Sorensen, D.K. (Minnesota Univ., St. Paul (USA). Coll. of Veterinary Medicine). 30 Apr 1976. Contract E(11-1)-910. 11p. Dep. NTIS $3.50.

We have consistently demonstrated viral like particles in mitogen stimulated lymphocyte cultures from leukemic cows and cows with a persistent lymphocytosis. Our electron microscopic studies of these particles have shown them to be similar to the known oncogenic RNA viruses in size, plasma membrane budding, and in their C-type morphology. We have concentrated these bovine C-type particles approximately 1,000 fold by continuous flow ultracentrifugation. Our investigations employing these concentrated particles have indicated that they are RNA containing, possess an RNA directed DNA polymerase, and band in a sucrose density gradient at a density of 1.17 gm/cm^3. The goal of our current study is to conclusively prove the viral etiology of bovine leukemia.

PHYSIOLOGICAL SYSTEMS

26596 **College athletics, body size, and cancer mortality.** Polednak, A.P. (Argonne National Lab., IL). *Cancer;* **38**: No. 1, 382-387(Jul 1976).

Data are presented on mortality from neoplasms as determined from death certificates in a cohort of 8393 college men, according to athletic status in college. Major athletes (lettermen) died significantly more often from neoplasms than nonathletes. Mean age at death from neoplasms (underlying cause) was significantly lower in major athletes than in both minor athletes and nonathletes. After matching major athletes with nonathletes of comparable body size (height and weight), differences in proportional mortality and mean age at death from neoplasms persisted, although not statistically significant for the smaller samples. Correlation coefficients (Pearson r) and partial r's between weight in college and age at death from neoplasms were negative but of low magnitude. Some possible explanations for the differences between major athletes and nonathletes are discussed.

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 26451

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 25553

26597 (COM—75-10722) **Growth and maturity of two groups of oysters ('Crassostrea virginica' Gmelin), maintained in cooling water at an estuarine electric power generating station.** Gilmore, G.H.; Ray, S.M.; Aldrich, D.V. (Texas Agricultural and Mechanical Univ., Galveston (USA). Dept. of Marine Sciences). Jan 1975. 74p. (TAMU-SG—75-207). NTIS $4.25.

Growth and mortality of oysters with high and low levels of Labyrinthomyxa marina (L) infection were measured during 1972 in 0.1 ha ponds receiving a continuous flow of heated water from an electric power plant; the power plant intake canal; and the power plant discharge canal. Pond oysters had less cumulative mortality than intake or discharge canal oysters, regardless of Labyrinthomyxa infection. Only pond oysters (high-L and low-L) gained in biomass (increasing 171 and 5,953 g or 2 and 25%, respectively) by the end of the study. In the intake canal low-L oysters decreased 6,293 g(27%) in the 10-month period prior to their disappearance while high-L oysters decreased 6,633 g (64%) by the end of the study. Oysters placed in the discharge canal during warm weather died within six weeks. Oysters held in the ponds grew as well or better than oysters from a natural reef in Galveston Bay. (GRA)

26598 **Resource costs of agricultural production.** Krummel, J. (Cornell Univ., Ithaca, NY). pp 359-370 of In Clean fuels from biomass, sewage, urban refuse, and agricultural wastes. Chicago; Inst. of Gas Tech. (1976).

From Symposium on clean fuels from biomass, sewage, urban refuse, agricultural wastes; Orlando, Florida, United States of America (USA) (27 Jan 1976).

See CONF-760132—.

The resource inputs of energy, land, and labor are analyzed for various food production systems. U. S.-type intensive agriculture relies on large amounts of fossil fuel, fertilizer, and machinery to obtain high food yields. The ratio of the kilocalorie return of food energy to the total energy input is relatively low, ranging from 0.65 to 2.52 for the intensive crop production systems discussed. Animal production systems use 5 to 37 times as much fossil fuel as crop systems. Low-energy food production systems have higher energy-return ratios, but the food yields are lower than the energy-intensive systems. Alternatives to present energy-intensive food production systems are discussed. The substitution of labor in place of machinery is seen as a viable alternative where there are adequate labor resources. Alternative agricultural practices are seen as "buying time" until the problem of overpopulation is solved. The dependence of U. S.-type agricultural production and "green revolution" agriculture on high energy inputs is precarious if fossil—fuel shortages become critical. There is already insufficient land and fossil-fuel energy to support the world population on the U. S.-type diet. 41 references.

BIOMEDICAL SCIENCES, APPLIED STUDIES

REFER ALSO TO CITATION(S) 26761

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

REFER ALSO TO CITATION(S) 26605

26599 (ERDA-tr—146, pp 104-107) **Stability of the conformation of the DNA double helix to gamma irradiation.** Kondakova,

N.V.; Lobachev, V.M.; Tselikova, S.V. (Inst. of Biological Physics, Pushchino, USSR). 1975. Translated from Radiobiologiya; 15: No. 5, 722-724(1975).

In Radiobiology.

It is known that in the cell, DNA contained in the chromatin is in a C-conformation. There are also representations of the change in the conformational state of DNA during the process of its functioning. In view of this, one of the possible causes of the disturbance of the functioning of DNA in the irradiated cell may be a change in its ability for conformational conversions as a result of radiation damages (breaks in the sugar phosphate chains, modification of bases, etc.). In this work we investigated the influence of γ irradiation on the conformational state of DNA, as well as the ability of DNA for the B yields C conformational transition, by the method of circular dichroism (CD), sensitive to a change in the parameter of the DNA double helix.

26600 Effects of metal ions on the formation of radicals and chain breaks in ultraviolet-radiated polyadenylic acid and collagen. Friedberg, F. (Howard Univ., Washington, DC). *Radiat. Res.*; **66**: No. 1, 174-179(Apr 1976).

The protective effect of certain metal ions on the ultraviolet radiolysis of polyadenylic acid and of lathyritic collagen in the dry state are investigated in the absence of air. For polyadenylic acid, both formation of stable radicals at room temperature and decrease in average molecular weight are slightly depressed in the presence of metal. For collagen, however, a lowering in radical concentration is difficult to discern while prevention of molecular weight decreases are definite when the metal salts are added.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

REFER ALSO TO CITATION(S) 26616, 26617, 26622, 26623, 26635

26601 (ERDA-tr—146, pp 24-36) **Mathematical model of one of the methods of modification of the radiosensitivity of cells.** Chernavskii, D.S.; Palamarchuk, E.K.; Kalendo, G.S.; Kalendo, Yu.I. (Lebedev Inst. of Physics, Moscow). 1975. Translated from Radiobiologiya; 15: No. 5, 662-670(1975).

In Radiobiology.

A mathematical model is proposed for the action of radiation on cells, considering: the appearance of radiation damages; the influence of ionizing radiation on cell metabolism; the influence of the metabolic rate on the realization of radiation damages; the role of the time factor in irradiation. The model described the radiosensitization of cells during preliminary irradiation at doses below the threshold of inhibition, the protective effect when the preliminary dose is increased slightly, and predicts the possible effects of sensitization at increased preliminary doses and long intervals between irradiations.

26602 (ERDA-tr—146, pp 37-41) **Influence of certain chemical compounds on the radiation hemolysis of erythrocytes.** Kolesnikov, Yu.A.; Shul'gina, M.A.; Yartsev, E.I.; Novosel'tseva, S.D.; Bogatyrev, G.P. (Inst. of Biophysics, Moscow). 1975. Translated from Radiobiologiya; 15: No. 5, 671-674(1975).

In Radiobiology.

On a model of radiation hemolysis of erythrocytes, the greatest radioprotective activity was exhibited by sulfur-containing radioprotectors, serotonin, and arginine. The addidition of radioprotectors to the medium after irradiation did not influence the development of postradiation hemolysis. It was found that certain amino acids (proline, serine) have a pronounced radioprotective effect when they are introduced into the medium after irradiation. Under the same conditions taurine had the most substantial effect on the development of radiation hemolysis. The mechanism of the action of these substances does not involve an increase in the osmotic pressure of the medium and is probably explained by normalization of the functional state of the cell membrane and processes of cell metabolism.

26603 (ERDA-tr—146, pp 48-53) **Role of direct protection of cells of the hematogenic system in the radioprotective action of certain biogenic amines on the animal organism.** Smirnova, I.B.; Dontsova, G.V.; Yanushevskaya, M.I.; Graevskii, E.Ya. (Inst. of Developmental Biology, Moscow). 1975. Translated from Radiobiologiya; 15: No. 5, 680-683(1975).

In Radiobiology.

It was established by the method of spleen exocolonies on mice that serotonin, adrenaline, and noradrenaline possess the ability to protect both isolated bone marrow cells and cells in situ; a significant fraction in the radioprotective action of the investigated amines on the animal organism consists of the direct protective action on their cells; in the case of serotonin and adrenaline, the cell protection in the organism is supplemented by the radioprotective action of tissue hypoxia induced by these amines.

26604 Note on the effects of fractionation of high LET radiations. Rossi, H.H. (Columbia Univ., NY). *Radiat. Res.*; **66**: No. 1, 170-173(Apr 1976).

It is well established that at a given level of cell survival fractionation reduces the effect of low LET radiation more than that of high LET radiation. However, theoretical considerations indicate that at a given absorbed dose fractionation should result in an increase of cell survival by a factor that is substantially independent of radiation quality. Experimental data confirm this expectation.

26605 Enhancement of postreplication repair in Chinese hamster cells. D'Ambrosio, S.M.; Setlow, R.B. (Brookhaven National Lab., Upton, NY). *Proc. Natl. Acad. Sci. U.S.A.*; **73**: No. 7, 2396-2400(Jul 1976).

Alkaline sedimentation profiles of pulse-labeled DNA from Chinese hamster cells showed that DNA from cells treated with N-acetoxy-acetylaminofluorene or ultraviolet radiation was made in segments smaller than those from untreated cells. Cells treated with a small dose (2.5 μM) of N-acetoxy-acetylaminofluorene or(2.5 J . m^{-2}) 254-nm radiation, several hours before a larger dose (7 to 10 μM) of N-acetoxy-acetylaminofluorene or 5.0 J m^{-2} of 254-nm radiation, also synthesized small DNA after the second dose. However, the rate at which this small DNA was joined together into parental size was appreciably greater than in absence of the small dose. This enhancement of postreplication repair (as a result of the initial small dose) was not observed when cells were incubated with cycloheximide between the two treatments. The results suggest that N-acetoxy-acetylaminofluorene and ultraviolet-damaged DNA from Chinese hamster cells are repaired by similar postreplicative mechanisms that require de novo protein synthesis for enhancement.

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

REFER ALSO TO CITATION(S) 26578

26606 (ORO—3941-30) **Mechanisms of recombination and function of DNA in bacteria. Progress report, May 3, 1975—May 5, 1976.** Guild, W.R. (Duke Univ., Durham, N.C. (USA). Dept. of Biochemistry). 1976. Contract E(40-1)-3941. 5p. Dep. NTIS $3.50.

Results of investigations on phages were obtained with regard to the finding of transfection and characterizing the mode of entry of transfecting DNA; the characterization of a DNAase-resistant gene transfer agent from phage-infected cells which has some of the properties of a generalized transducing phage; and the study of multiplicity reactivation of uv-irradiated phage in a uv-sensitive pneumococcal host. Progress is also reported on a new gene transfer process, cell mutants, fine structure mapping, and stimulated recombination. (HLW)

26607 (ERDA-tr—146, pp 155-158) **Influence of photonuclear reactions on the inactivation of bacterial cells under the action of bremsstrahlung.** Kapchigashev, S.P.; Kovalev, V.P.; Tsuladze, N.G. 1975. Translated from Radiobiologiya; 15: No. 5, 757-759(1975).

In Radiobiology.

A culture of Escherichia coli was exposed to bremsstrahlung and gamma radiation. The survival of cells was determined by counting colonies in petri dishes after the incubation period for irradiated and control samples. Graphs are presented to show effects of dose on survival and equations are developed to determine comparative effectiveness of bremsstrahlung and gamma radiation. Effects of the pulsed nature of bremsstrahlung, differences in dose rates, and errors in dosimetry are discussed. (HLW)

RADIATION EFFECTS ON PLANTS

BASIC STUDIES

26608 (ERDA-tr—146, pp 108-110) **Effects of gamma irradiation on the nucleotide composition of t-RNA of the cotton plant.** Karakuziev, T.U. (All-Union Scientific Research Inst. of Cotton Raising, Tashkent). 1975. Translated from Radiobiologiya; 15: No. 5, 725-726(1975).

In Radiobiology.

It has been established that tRNA occupies a special place in protein biosynthesis. We have shown that irradiation leads to a suppression of the acceptor activity of tRNA in two-day etiolated cotton seedlings, and the acceptor function of tRNA of different amino acid specificities is impaired to different degrees. Analogously to tRNA, the isoacceptor tRNAs are also inactivated differently under the action of irradiation. In this work we studied the influence of γ rays on the nucleotide composition of tRNA of the cotton plant.

26609 (ERDA-tr—146, pp 142-145) **Molecular mechanisms of the stimulating action of ionizing radiation on seeds. Activation of ribonucleic acid synthesis.** Kuzin, A.M.; Vagabova, M.E.; Primak-Mirolyubov, V.N. (Inst. of Biological Physics, Pushchino, USSR). 1975. Translated from Radiobiologiya; 15: No. 5, 747-750(1975).

In Radiobiology.

Castor bean seeds were given 4 kR of gamma radiation and placed in petri dishes with tap water which caused the seeds to swell. At intervals up to 24 hrs seeds were removed, longitudinal sections were made, and radioautographs were prepared. Results showed that RNA synthesis increased in intensity following irradiation as a linear function of time. (HLW)

26610 (ERDA-tr—146, pp 163-167) **Cytogenetic action of extracts from gamma-irradiated potato tubers on mouse bone marrow.** Kuzin, A.M.; Osipova I.N.; Kopylov, V.A. (Inst. of Biological Physics, Pushchino, USSR). 1975. Translated from Radiobiologiya; 15: No. 5, 763-766(1975).

In Radiobiology.

Four groups of mice were treated as follows: the first group was given extracts from irradiated potatoes orally; the second group was given extracts from non-irradiated potatoes; the third group was given physiological saline; and the fourth group was subjected to gamma radiation. The animals were killed and bone marrow cells were examined for chromosomal aberrations. The tabulated results show that extracts from irradiated potatoes produced a significant increase in the frequency of cells with chromosomal aberrations. The increased induction of chromosomal aberrations indicated that radiotoxins were present in the irradiated potatoes. (HLW)

26611 (ERDA-tr—146, pp 205-207) **Influence of preplanting gamma irradiation on the biology and yield of cucumbers.** Zham'yansuren, D.; Zhugder, A. (Inst. of Physics and Tech., Dzunkhara, Mongolia). 1975. Translated from Radiobiologiya; 15: No. 5, 790-792(1975).

In Radiobiology.

Dry cucumber seeds were exposed to gamma radiation in doses of 500 to 6000 R. The irradiated seeds were germinated and the seedlings were transplanted to the field. Measurements were made on plants and fruits and the dry weight and total sugar in fruits were determined. Results showed that the yield was increased by 15 to 18 percent following doses of 500 to 2000 R. The increased yield was attributed to an increase in the ratio of male to female flowers and to an increase in the number of fruits obtained, an increase in the weight of fruits, an increase in the dry weight, and an increase in sugar content. (HLW)

RADIATION EFFECTS ON ANIMALS

MAN

26612 Control of dose administered once a week and three times a day according to schedules calculated by the CRE formula, using skin reaction as a biological parameter. Turesson, I.; Notter, G. (Univ. of Gothenburg, Sweden). *Radiology;* **120**: No. 2, 399-404(Aug 1976).

Patients with breast cancer were irradiated postoperatively to bilateral parasternal fields. The validity of the Cumulative Radiation Effect (CRE) formula for treatment once a week and three times a day was analyzed, and both schedules were compared with treatment once a day (five times a week). The biological radiation effect on normal tissue was studied by reflectance spectrophotometry of skin erythema and pigmentation. Early skin reactions were identical after irradiation daily and once a week, respectively, but were found to be significantly more pronounced after irradiation three times a day than after treatment once a day, corresponding to an overexposure of 7 to 10 percent.

VERTEBRATES

REFER ALSO TO CITATION(S) 26570

26613 (COO—1024-55) **Comparison of the cytological effects produced by ionizing radiations of different LET. Progress report, April 1975—April 1976.** Riley, E.F. Jr. (Iowa Univ., Iowa City (USA). Radiation Research Lab.). Apr 1976. Contract E(11-1)-1024. 23p. Dep. NTIS $3.50.

Rat eyes were irradiated with a single dose of 1000, 850, 700, or 550 rads of x-radiation or 225, 200, 175, 150, or 125 rads of fission neutron radiation. Some eyes are being examined periodically for cataracts; others were tested by wounding the lens at 3, 14, or 28 days after irradiation. At 10 months after irradiation, the 1000-rad-X cataracts were a bit more advanced than the 225-rad-n group; this suggests an RBE of about 4. Wounding the lens initiated a "wave" of DNA synthesis followed by a "wave" of mitotic activity. Radiation partially suppressed the response to wounding. The magnitude of the response was inversely related to the x-ray dose; the magnitude increased with increased time between irradiation and wounding. We are accumulating data to compare neutron and x-irradiated epithelia. Equal percentages of abnormal mitoses were observed after wounding at 3 days after 1000 rad-X or 222 rad-n; this suggests an RBE of 4.4. X-irradiated cells recovered continually during the first 28 days after irradiation. Neutron irradiated cells recovered very little in the first two weeks, but then "caught up" to X-irradiated cells. Shielding half of a lens from 1000 rads of x-rays slightly decreased the immediate effects on irradiated cells and enabled the cells to recover faster.

26614 (COO—1024-56) **Comparison of the cytological effects produced by ionizing radiations of different LET. Three-year summary of project activities from April 1973—April 1976.** Riley, E.F. Jr. (Iowa Univ., Iowa City (USA). Radiation Research Lab.). Apr 1976. Contract E(11-1)-1024. 29p. Dep. NTIS $4.00.

In the past 3 years, we have irradiated about 600 mice with single or fractionated doses of x-rays or fission neutrons and have tested the lens epithelia by wounding at 1 hour, 1 week, 2 weeks, or 4 weeks post-irradiation, irradiated about 900 rats with a single dose from a graded series of single doses of x-rays or fission neutrons and tested the lens epithelia by wounding at 3, 14, or 28 days post-irradiation (plus about 100 control lens epithelia), irradiated either half of a rat lens or the entire lens to compare the immediate effects on the wound response and recovery rates in the half-irradiated and whole-irradiated epithelia, and done a pilot study on cAMP and RNA synthesis in the hours soon after wounding. Most of our results indicate an RBE from 4 to 5. Our data usually show a continual recovery during the first month after x-irradiation. The neutron irradiated tissues often show little recovery during the first week or two, but then "catch up" to the recovering x-irradiated tissues. Fractionation usually results in a "sparing effect" but fractionation of neutron doses enhanced the effect on a cell population with a slow, but steady cell turnover rate. Shielding half a lens enables the irradiated cells to recover faster.

26615 (COO—3380-23) **Rat skin carcinogenesis as a basis for estimating risks at low doses and dose rates of various types of radiation.** Burns, F.J.; Vanderlaan, M.; Strickland, P.; Albert, R.E. (New York Univ., N.Y. (USA). Inst. of Environmental Medicine). 1976. Contract E(11-1)-3380. 15p. (CONF-760445—4). Dep. NTIS $3.50.

From 3. international symposium on detection and prevention of cancer; New York City, New York, United States of America (USA) (26 Apr 1976).

The recovery rate, age dependence and latent period for tumor induction in rat skin were measured for single and split doses of radiation, and the data were analyzed in terms of a general model in an attempt to estimate the expected tumor response for various types of radiation given at low dose rates for long periods of time. The dorsal skin of male rats was exposed to electrons, x rays, or protons in either single or split doses for several doses and the tumor responses were compared during 80 weeks of observation. A two stage model incorporating a reversible or recoverable mode was developed and various parameters in the model, including recovery rate, dose-response coefficients, and indices of age sensitivity, were evaluated experimentally. The measured parameters were then utilized to calculate expected tumor responses for exposure periods extending for duration of life. The calculations indicated that low dose rates could be markedly ($^1/_{100}$ to $^1/_{1000}$) less effective in producing tumors than the same dose given in a short or acute exposure, although the magnitude of the reduction in effectiveness declines as the dose declines.

26616 (ERDA-tr—146) **Radiobiology.** Translation of *Radiobiologiya;* **15**: No. 5, 643-800(1975). 220p. Dep. NTIS $7.75.

Separate abstracts were prepared for the 41 papers presented in the journal. (HLW)

26617 (ERDA-tr—146, pp 1-5) **Comparison of various methods of isolation of nuclear and cytoplasmic RNA from the livers of irradiated rats.** Tokarskaya, V.I. (Inst. of Biological Physics, Pushchino, USSR). 1975. Translated from Radiobiologiya; 15: No. 5, 643-646(1975).

In Radiobiology.

The nuclei from the livers of control and irradiated rats (800 rad, immediately after irradiation) were purified by various methods (phenol, citrate, with triton X-100, by ultracentrifugation in 2.2 M sucrose), and RNA was isolated from them. According to all the investigated parameters (yield of RNA, specific activity, amount of poly(A)-containing RNA, hybridizability, distribution in sucrose gradient), irradiation does not affect either the properties of the nuclear RNAs or their extractability. In the case of purification of liver nuclei of irradiated rats by the citrate method or with triton-X-100, there is a loss of part of the nuclear RNAs. It was shown that the phenol method is most suitable for studying the metabolism of giant nuclear RNAs, and purification of the nuclei in 2.2 M sucrose is most suitable for the analysis of transport of RNA.

26618 (ERDA-tr—146, pp 6-10) **Role of endogenous substances in the creation of a background of increased radioresistance. Communication 7. Investigation of the influence of dopamine and histamine on lipid radiosensitizers.** Zhamsaranova, S.D.; Sobolev, A.S.; Orekhov, A.N.; Goncharenko, E.N.; Kudryashov, Yu.B. (Moscow State Univ.). 1975. Translated from Radiobiologiya; 15: No. 5, 647-650(1975).

In Radiobiology.

The influence of histamine and dopamine on the level of endogenous radiosensitizers was demonstrated at the subcellular and tissue levels. On the basis of the data obtained, a possible mechanism is suggested for the cell protection of these biogenic amines. A series of experiments was conducted to determine the mechanisms of the interaction of histamine and dopamine with products of peroxide oxidation of lipids.

26619 (ERDA-tr—146, pp 11-17) **Influence of prolonged gamma irradiation of rats on the biosynthesis of pyrimidine ribonucleotides.** Koshcheenko, N.N.; Atabekov, A.Yu.; Romantsev, E.F. 1975. Translated from Radiobiologiya; 15: No. 5, 651-656(1975).

In Radiobiology.

It was established that the ability of spleen and especially thymus tissue for de novo synthesis of UMP decreases sharply with time of total γ irradiation of rats at a dose of 1100 R (LD/sub 100/30/; dose rate 0.8 R/min) and reaches a minimum level two days after the radiation influence, but then increases somewhat. The radiation damage to the uracil phosphoribosyltransferase pathway of UMP synthesis in lymphoid tissues is not profound, and is reversible. The activity of UMP kinase is sharply and reversibly reduced in these organs. There are no postradiation changes in the de novo biosynthesis of UMP and the UMP kinase activity in the liver, but UMP synthesis from uracil is gradually inhibited. In all the tissues studied, prolonged irradiation does not inhibit the process of conversion of uridylic nucleotides to cytidylic forms.

26620 (ERDA-tr—146, pp 18-23) **Peculiarities of the regeneration of bone marrow of mice under the influence of sublethal doses of radiation.** Barakina, N.F. (Inst. of Developmental Biology, Moscow). 1975. Translated from Radiobiologiya; 15: No. 5, 657-661(1975).

In Radiobiology.

It was shown that the lymphato-like x-cells, which are accumulated in the bone marrow after sublethal irradiation of mice, are not polypotent stem cells, are not precursors of granulocytic or erythroid cells, but represent thymus-independent lymphocytes (B) or their precursors.

26621 (ERDA-tr—146, pp 42-47) **Change in the number of colony-forming units of the mouse bone marrow in the process of irradiation at different dose rates.** Shvets,V.N.; Gorlov, V.G. 1975. Translated from Radiobiologiya; 15: No. 5, 675-679(1975).

In Radiobiology.

Whole-body irradiation of mice for a year at a dose rate of 0.5 to 10 R/day does not produce any changes in the numbers of CFU and nucleated bone marrow cells. The effectiveness of irradiation with a dose rate of 100 R/day—300 R/min—depends on the value of the accumulated dose and the dose rate. A graphical expression of this dependence permitted a determination of the value of the threshold dose rate for various total doses of irradiation by extrapolation. It was found that there is a linear relationship between the value of the threshold dose rate and the accumulated dose of irradiation.

26622 (ERDA-tr—146, pp 54-56) **Significance of the spleen in the differentiation of T-cells, which exhibit an auxiliary function in the humoral immune responses in the bodies of lethally irradiated recipients after transplantation of bone marrow.** Gambarov, S.S.; Petrov, R.V.; Khaitov, R.M.; Norimov, A.Sh. 1975. Translated from Radiobiologiya; 15: No. 5, 684-686(1975).

In Radiobiology.

It was shown in experiments on mice that in the spleens of secondarily irradiated recipients of B cells, which had received thymus or lymph node cells (T-cells) from splenectomized animals protected with bone marrow, several times fewer antibody-forming cells are accumulated than when T-cells from nonsplenectomized donors are administered. Possibly the spleen plays a definite role in the differentiation of T-cells (which cooperate with the B-cells) from bone marrow precursors.

26623 (ERDA-tr—146, pp 57-61) **Radiosensitivity of normal, regenerating, and embryonic corneal epithelium of mice.** Studitskii, A.N.; Popova, M.F.; Bulyakova, N.V. (Inst. of Evolutionary, Morphology, and Ecology of Animals, Moscow). 1975. Translated from Radiobiologiya; 15: No. 5, 687-690(1975).

In Radiobiology.

A quantitative cytogenetic investigation was made of the influence of x rays on the normal and regenerating corneal epithelium of adult mice, as well as the corneal epithelium of newborn mice of the C57Bl line. It was shown that the regenerating and embryonic epithelium are more resistant in comparison with the normal epithelium of adult mice. This phenomenon is expressed in a substantial shortening of the block of mitosis that occurs after irradiation and a lower number of cells with chromosome aberrations. The results obtained show that the radiosensitivity of tissues in various functional states is determined not so much by the intensity of proliferation, as by structuro-metabolic peculiarities.

26624 (ERDA-tr—146, pp 67-72) **Influence of mexamine on the functional state of the pituitary-adrenocortical system of rats during irradiation.** Lebedev, V.G.; Rogozkin, V.D.; Romashko, O.O. 1975. Translated from Radiobiologiya; 15: No. 5, 695-699(1975).

In Radiobiology.

If mexamine is administered before irradiation, in the adrenals and peripheral blood plasma of rats in the first hours after the influence, the corticosterone content is sharply increased. On the other hand, the radioprotector prevents the appearance of secondary hypercorticism which develops two to three days after irradiation without protection.

26625 (ERDA-tr—146, pp 73-78) **Serum globulins as radioprotective preparations.** Shal'nova, G.A.; Kuz'mina, T.D.; Ulanova, A.M. 1975. Translated from Radiobiologiya; 15: No. 5, 700-703(1975).

In Radiobiology.

It has been established that the therapeutic administration of preparations of serum globulins (subcutaneously, three times in amounts of 100 mg protein/kg 2, 24, and 48 hrs after irradiation with the γ rays of ^{60}Co) increases the survival of irradiated (LD/sub 60-80/30/) animals (mice, rats, guinea pigs, rabbits) by more than 20 to 40 percent. It has been found that the more autoantibodies in the preparations, the higher their radioprotective effect. It has been shown that using the method of hemostimulation it is possible to increase the level of normal autoantibodies in the blood for the subsequent production of preparations of serum globulins with a high content of antitissue antibodies and their use for the treatment of acute radiation sickness.

26626 (ERDA-tr—146, pp 84-89) **Characteristics of radiation syndromes in the case of nonuniform irradiation.** Avetisov, G.M.; Darenskaya, N.G.; Zaitseva, R.N. 1975. Translated from Radiobiologiya; 15: No. 5, 708-711(1975).

In Radiobiology.

The quantitative characteristics of the development of the hemopoietic, intestinal, and oral syndromes were studied on noninbred male rats, subjected to uniform, total nonuniform, and partial (on the region of the head, abdomen, anterior and posterior portions of the abdomen, posterior half of the body) x ray (180 to 250 kV, 60 to 200 R/min) irradiation. The dose range of the lethal appearance of the intestinal syndrome in the case of uniform irradiation lies within the range 400 to 700 rad, and in the case of influences with shielding of the region of the abdomen, extends to 850 rad. The dose range of the intestinal and oral syndromes in the case of partial irradiation of the region of the abdomen and head was 1150 to 1500 and 1400 to 1800 rad, respectively.

26627 (ERDA-tr—146, pp 90-95) **Radioprotective action of serotonin.** Vodop'yanova, L.G.; Vinogradova, M.F. (Leningrad State Univ.). 1975. Translated from Radiobiologiya; 15: No. 5, 712-715(1975).

In Radiobiology.

The influence of serotonin on oxidative phosphorylation in rat liver mitochondria was studied in experiments in vitro. It was shown that serotonin in a concentration of 2×10^{-4} M inhibits the oxidation of α-ketoglutaric acid (an NAD-dependent substrate), without significantly changing the succinic acid consumption. A comparison of the data obtained with the literature data has made

it possible to suggest that in addition to the already known ability to produce tissue hypoxia, the radioprotective effect of serotonin is based on its ability to influence oxidative processes in the mitochondria.

26628 (ERDA-tr—146, pp 96-103) **Spontaneous and induced luminescence of blood serum as an index of the degree of radiation damage to animals.** Serkiz, Ya.I.; Ryabova, E.Z.; Chebotarev, E.E. (Inst. of Molecular Biology and Genetics, Kiev). 1975. Translated from Radiobiologiya; 15: No. 5, 716-721(1975).

In Radiobiology.

Spontaneous and electrochemiluminescence as well as the dynamics of the luminescence spectra of the blood serum of rats after their irradiation with fast neutrons, were studied in the work. It was shown that the dynamic principles of the ultraweak luminescence of blood serum reflects the degree of radiation damage to the animals. It was established that the nature of the luminescence spectrum of the blood serum of rats changes in the dynamics of radiation pathology.

26629 (ERDA-tr—146, pp 111-116) **Influence of irradiation and certain sulfur-containing compounds of the 3′:5′-cyclo-amp-phosphodiesterase activity of tissue homogenates of experimental animals.** Zhivotova, N.I.; Pushkareva, N.B.; Filippovich, I.V.; Romantsev, E.F. 1975. Translated from Radiobiologiya; 15: No. 5, 726-729(1975).

In Radiobiology.

Recently cyclic adenosine-3′,5′-monophosphate has been attributed even greater importance as a universal regulator of biochemical processes, occurring both in the tissues of mammals and in the cells of bacteria. It has been shown that cAMP is a mediator of the action of many polypeptide hormones and catecholamines. According to the data of a number of authors, a study of the change in the pool of endogenous cAMP may be of vital importance for an understanding of individual aspects of the pathogenesis of radiation sickness and the mechanism of the action of radioprotectors of various classes. Therefore, the purpose of our work was a study of the state of 3′,5′-cAMP-phosphodiesterase of the rat liver and spleen, as well as muscle tissue of mice in the case of irradiation of animals and under the influence of MEA and other sulfur-containing compounds.

26630 (ERDA-tr—146, pp 117-119) **Peroxides and radiation disruption of oxidative phosphorylation.** Dovgii, I.E.; Akoev, I.G. (Inst. of Biological Physics, Pushchino, USSR). 1975. Translated from Radiobiologiya; 15: No. 5, 730-732(1975).

In Radiobiology.

In a consideration of the initial processes arising in the irradiated cell, it is necessary to evaluate the possible role of peroxides in the injurious action of irradiation and the disruption of oxidative phosphorylation (OP). To determine the possible mechanism of the influence of peroxide compounds on oxidative phosphorylation under the action of radiation, we determined their amount and peroxidase activity in rat liver mitochondria at various periods (after 10 min, 2 and 24 hrs) after total irradiation of the animals.

26631 (ERDA-tr—146, pp 120-127) **Copper and iron content in tissues of rabbits under the influence of x-rays.** Gotsulyak, L.I. (Odessa Medical Inst., USSR). 1975. Translated from Radiobiologiya; 15: No. 5, 732-737(1975).

In Radiobiology.

Rabbits were given 450 R of x radiation in a single whole-body dose. Samples of nerve tissue, blood, small intestine, bones, urine, and feces were analyzed for copper and iron at intervals up to 30 days following irradiation. The results demonstrated a redistribution of copper and iron in various tissues at different times following irradiation and a loss of trace elements by the irradiated animal. A rather substantial increase in copper and iron was observed at certain periods following irradiation. (HLW)

26632 (ERDA-tr—146, pp 132-136) **DNA-dependent RNA polymerase of the organs of irradiated animals. Communication 6. The role of changes in the enzyme in disturbances of processes of transcription.** Likhoded, V.S.; Stolyarov, I.V.; Savenko, L.N.; Paskevich, I.F. (Kharkov Scientific Research Inst. of Medical Radiology). 1975. Translated from Radiobiologiya; 15: No. 5, 741-744(1975).

In Radiobiology.

We isolated and characterized two forms of DNA-dependent RNA polymerase from the rat liver and spleen: nucleolar—form A, responsible for the synthesis of rRNA, and nucleoplasmic—form B, responsible for the synthesis of mRNA. No significant differences were detected in the metabolic activity, nature of the chromatographic separation on ion exchangers, and optimum activity as a function of the concentration of Mn^{2+}, Mg^{2+}, and $(NH_4)_2SO_4$ for RNA polymerases isolated from the liver and spleen. This circumstance permits us to suggest that the different levels of RNA synthesis in the liver and spleen of normal animals is determined by other components of the regulatory system of transcription. At the same time, it has been established that the synthesis of RNA polymerases in both organs undergoes substantial changes after the irradiation of the animals. An increase in the incorporation of the labeled precursor into the RNA polymerases AI, AII, and B was noted after 24 and 48 hrs (dose 800 R), and an inhibition of this process was noted after 120 hrs. In the spleen irradiation produces a sharp decrease in the synthesis of RNA polymerases at all the investigated periods; moreover, just as in the liver, the biosynthesis of RNA polymerase B is subject to relatively large changes.

26633 (ERDA-tr—146, pp 137-141) **Dynamics of free and bound urea and activity of arginase in regions of the guinea pig brain during irradiation.** Agafonova, I.M.; Ponomareva, T.F. (Voroshilovgrad Pedagogical Inst., USSR). 1975. Translated from Radiobiologiya; 15: No. 5, 744-747(1975).

In Radiobiology.

Guinea pigs were exposed to a single total dose of 650 R of x radiation and the brains were prepared for chemical analysis. The concentrations of free and bound urea were increased in all regions of the brain. There was an increase in arginase activity that was correlated with the increase in free urea. The data indicated that free and bound urea increase the radioresistance of the organism. (HLW)

26634 (ERDA-tr—146, pp 146-150) **Mechanism of the action of relatively low doses of ionizing radiation on the compartmentalization of amino acids in the central nervous system.** Dovgalevich, I.I. (Simferopol State Univ., USSR). 1975. Translated from Radiobiologiya; 15: No. 5, 750-754(1975).

In Radiobiology.

One and two-day-old rats were x-irradiated and one hr later were subjected to pain stress. Mature male rats were treated with x and gamma radiation and fast electrons. Analysis of gray and white matter showed a decrease in the amino acids of mature rats following irradiation. Following pain stress and irradiation an increase in the amino acids of the nervous system was found. Compartmentalization of amino acids of the central nervous system of animals irradiated with relatively low doses of ionizing radiations depends on the nature of the radiation, the functional maturity of the individual elements and integrating systems of the organism, and is determined both by specific and nonspecific components. (HLW)

26635 (ERDA-tr—146, pp 151-154) **Mechanism of the radiosensitizing action of methylhydrazine.** Lieh Suang T'u; Yanushevskaya, M.I.; Smirnova, I.B.; Graevskii, E.Ya. (Inst. of Developmental Biology, Moscow). 1975. Translated from Radiobiologiya; 15: No. 5, 754-757(1975).

In Radiobiology.

Methylhydrazine was injected intraperitoneally into mice and 15 min later they were exposed to 210 kV of x radiation. The criterion of radiosensitivity was the survival of the mice for 30 days after irradiation and the average lifetime of the animals that died during this period. Other experiments were conducted on Ehrlich's ascites cells in which methylhydrazine was added to the cell suspension and the cells were irradiated 15 min later. Irradiated and control cells were injected intraperitoneally into intact mice and radiosensitivity was estimated according to induction of chromosome aberrations and the total number of cells in the abdominal cavity. Results showed that methylhydrazine has a strong sensitizing effect on the animals and on Ehrlich's ascites cells. It is suggested that the radiosensitizing effect is associated with the ability to reduce the amount of thiols. (HLW)

26636 (ERDA-tr—146, pp 159-162) **Metabolism of tissues of the intestinal epithelium as a possible index of the degree of radiation damage to the organism.** Puchkova, S.M.; Goloshchapova, Zh.A. 1975. Translated from Radiobiologiya; 15: No. 5, 760-762(1975).

In Radiobiology.

Following gamma radiation of mice experiments were conducted on protein synthesis in the intestinal wall and mitotic activity in the intestinal epithelium. Mercamine was administered to irradiated and unirradiated mice. Both protein synthesis and mitotic activity were inhibited in mice treated with radiation only; however, the inhibitory effects were not as pronounced in irradiated mice treated with mercamine. (HLW)

26637 (ERDA-tr—146, pp 168-171) **Influence of 5-methoxytryptamine, cystamine, and aminopropyl-aminoethyl thiophosphate on the radiosensitivity of hemopoietic stem cells.** Badul, Yu.A.; Butomo, N.V. (Military-Medical Academy, Leningrad). 1975. Translated from Radiobiologiya; 15: No. 5, 766-768(1975).

In Radiobiology.

Mice were gamma-irradiated in doses of 50 to 600 R; previous to irradiation three of the four groups of mice were given intraperitoneal injections of 5-methoxytryptamine, cystamine, and aminopropylaminoethyl thiophosphate. The animals were killed and bone marrow was removed and injected into irradiated mice. On the eighth day after transplantation the number of spleen colonies formed was calculated. Results showed that the radiosensitivity of hematopoietic stem cells was significantly reduced by the protectors. (HLW)

26638 (ERDA-tr—146, pp 172-176) **Effects of x irradiation on the choline mtabolism.** Vasil'ev, A.N.; Kucherenko, N.E. (Kiev State Univ.). 1975. Translated from Radiobiologiya; 15: No. 5, 769-771(1975).

In Radiobiology.

Rats were x-irradiated at a dose of 800 R and three hrs later they were killed. Procedures are described for isolating choline and phosphorylcholine from tissue extracts and for determining the activity of choline dehydrogenase. Results showed an increase in phosphorylcholine and free choline in the liver and muscles. The activity of choline dehydrogenase 3 hrs after irradiation was only 50 percent of the activity in normal animals. (HLW)

26639 (ERDA-tr—146, pp 177-181) **Changes in certain functional properties of the vessels of the intestines in whole-body gamma irradiation at supralethal doses.** Sushkevich, L.N.; Uklonskaya, L.I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). 1975. Translated from Radiobiologiya; 15: No. 5, 771-775(1975).

In Radiobiology.

To determine the possible role of vascular disorders in the pathogenesis of the intestinal syndrome, in this work we studied the state of the blood flow and permeability of the vessels in the small intestine of rats in the case of whole-body γ irradiation at supralethal doses. Thus, when the rats developed radiation sickness induced by γ irradiation at the median lethal doses, both the volume of blood flow and the permeability of the intestinal vessels are changed. These changes were especially pronounced three days after irradiation, at the height of the gastrointestinal symptoms. The increase in the volume of blood flow in the first hours after the radiation influence was replaced at first by a smooth decrease, and then by a sharp decrease in the period from the end of the second to the end of the third day. Considering the decrease in the number of exponents of the curve of elimination of the isotope, the increase in the half-life and residual radioactivity, it can be assumed that the blood flow is primarily disturbed in the regions of the microcirculatory channel of the intestine, which is characterized by the most rapid exponents.

26640 (ERDA-tr—146, pp 182-186) **Effectiveness of the action of radiation under conditions of nonuniform irradiation of the organism.** Airapetyan, G.M.; Ivashin, V.A.; Pugacheva, T.N. (Scientific Research Inst. on Biological Tests of Chemical Compounds, Kupavna). 1975. Translated from Radiobiologiya; 15: No. 5, 775-778(1975).

In Radiobiology.

Mice were x-irradiated at a dose rate of 106 R/min; 15 min before irradiation a mixture of cystaphos, AET, and mexamine was injected intraperitoneally. The radioprotective effect was estimated by the following criteria: total number of nucleated bone marrow cells of the femur 4 days after irradiation; number of CFU of the spleen and its weight at 9 to 10 days; 30-day survival; and average lifetime of the animals. Results are discussed in relation to effects of whole-body and partial-body irradiation. (HLW)

26641 (ERDA-tr—146, pp 196-199) **Prediction of the survival of rats in the case of partial shielding of the region of the abdomen.** Osokina, T.F.; Davydov, B.I.; Razgovorov, B.L. 1975. Translated from Radiobiologiya; 15: No. 5, 784-786(1975).

In Radiobiology.

Equations are developed for predicting survival of rats under conditions of partial shielding of the abdomen on the basis of the average absorbed dose in the abdominal region. Using cylindrical and spherical models the effect of shielding was determined on the basis of data on dose-survival relationships. To verify the mathematical model, experimental data obtained on rats for steel shields were used. (HLW)

26642 (ERDA-tr—146, pp 200-202) **Influence of sephadex on the state of the intestines of irradiated rats.** Fedorovskii, L.L. 1975. Translated from Radiobiologiya; 15: No. 5, 786-788(1975).

In Radiobiology.

Rats were gamma-irradiated at doses of 700 and 1200 R and Sephadex DEAE-A-25 was administered 1 hr, 1 day, and 2 days later. The frequency and intensity of diarrhea, the weight dynamics, and the survival of the rats were investigated. The frequency and intensity of diarrhea were reduced in animals treated with Sephadex. In the rats irradiated at a dose of 1200 R the average life span was 3.1 days for the control irradiated rats and 3.6 days for the treated animals. In the rats irradiated at 700 R the frequency of diarrhea was appreciably reduced and the DNA content of the intestinal mucosa and the intestinal alkaline phosphatase were increased. (HLW)

26643 **Prediction of the effective radioprotective dose of WR-2721 in humans through an interspecies tissue distribution study.** Washburn, L.C.; Rafter, J.J.; Hayes, R.L. (Oak Ridge Associated Univ., TN). *Radiat. Res.*; **66**: No. 1, 100-105(Apr 1976).

On the basis of earlier tissue distribution data, obtained in mice and rats, we proposed that the tissue distribution of intravenously injected S-2-[3-aminopropylamino]-ethylphosphorothioic acid (WR-2721) was more closely correlated with the injected dose per unit surface area than it was with the injected dose per unit body weight. To test this proposal, we have compared the tissue distribution of ^{35}S-labeled WR-2721 at 15 and 30 min after intravenous injection in mice, rats, rabbits, and dogs. The results of this study demonstrate that the tissue distribution is not a strict function of either the body weight or the surface area, but rather falls intermediate to the predictions of these parameters. By extrapolation, this observation would predict that a dose of 20 mg of WR-2721 per kilogram of body weight would provide humans with the same amount of protection that 100 mg/kg provides the mouse, i.e., a 50-80 percent increase in radiation resistance.

BASIC STUDIES

26644 **Developmental success of two species of Ips (Coleoptera: Scolytidae) in a chronically irradiated forest community.** Brower, J.H. (Brookhaven National Lab., Upton, N.Y. (USA); Massachusetts Univ., Amherst (USA)). *Can. Entomol.*; **106**: No. 3, 233-238(Mar 1974).

Pinus rigida trees exposed throughout the study to chronic gamma irradiation were inventoried to determine the intensity of attack by the bark beetles Ips grandicollis and I. calligraphus. Beetle developmental success was determined from bark samples by estimating the percentage of the cambial surface utilized. Trees killed by high radiation doses were attacked by the beetles even though radiation exposure proved lethal (greater than 500 r/day). In dead trees receiving lower doses adults survived but progeny were killed during different stages of development, depending on the dose rate. Developmental success was less on the exposed side of each tree than on the shielded side. Species with short life cycles have a survival advantage over those that have a long life cycle when exposed to chronic irradiation. (auth)

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

ANIMALS

REFER ALSO TO CITATION(S) 26184

26645 (ORO—3728-9) **Mutagenic effect of radionuclides incorporated into DNA of Drosophila melanogaster. Progress report, 1975—1976.** Lee, W.R. (Louisiana State Univ., Baton Rouge (USA). Dept. of Zoology and Physiology). 1976. Contract E(40-1)-3728. 14p. Dep. NTIS $3.50.

Progress is reported on research in the following areas: determination of mutagenic effects of tritium incorporated into DNA using ^{32}P, ^{33}P, and ^{14}C; dosimetry studies using number of disintegrations per minute per sperm cell; effect of the 5-position of the label of the cytosine moiety on mutation frequency; distribution of labeled thymine and comparison with labeled cytosine and a non-DNA labeled arginine-rich protein; detection of temperature sensitive mutants; induction of mosaics by x radiation; and methods for determining quantitatively the location of tritium in the deoxycytidine moiety. (HLW)

26646 (ERDA-tr—146, pp 62-66) **Probabilistic distribution of dose rates in the bone as a function of the rhythm of the strontium-90 administration and age of the animals.** Rasin, I.M.; Sarapul'tsev, I.A. 1975. Translated from Radiobiologiya; 15: No. 5, 691-694(1975).

In Radiobiology.

The probabilistic distribution of tissue doses in the skeleton was studied in experiment on pigs and dogs. It was established that in the case of oral administration of ^{90}Sr from birth up to 90 days, the probabilistic distribution of the dose rate is characterized by one set, and in adult animals by two independent sets, each of which corresponds to a normal law; in the case of prolonged excretion, both for growing and for adult animals, the probabilistic distribution of tissue doses in the tubular bones is characterized by two sets, and in the ribs and vertebrae by one independent set, each of which also corresponds to a normal law.

26647 (ERDA-tr—146, pp 79-83) **Nephrosclerosis in the case of various chronic radiation influences.** Lavrent'ev, L.N. (Leningrad Scientific Research Inst. of Radiation Hygiene). 1975. Translated from Radiobiologiya; 15: No. 5, 704-707(1975).

In Radiobiology.

In experiments on rats under the chronic action of ^{90}Sr, ^{137}Cs, and external irradiation, it was shown that nephrosclerosis develops with a frequency of 6.0 to 9.5 percent at total doses in the critical organs of 2000 to 2400 rad. ^{131}I did not cause the development of nephrosclerosis at doses of 3000 to 4000 rad in the thyroid gland. The development of nephrosclerosis is related both to the direct and to the indirect action of radiation.

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 25875, 26465, 26478

26648 (ERDA-tr—146, pp 187-190) **Content of Ca, ^{90}Sr, and ^{137}Cs in the human placenta.** Makarova, V.P.; Piskunov, L.I.; Treiger, S.I. (Sverdlovsk Regional Sanitary-Epidemiological Station, USSR). 1975. Translated from Radiobiologiya; 15: No. 5, 778-780(1975).

In Radiobiology.

The content of Ca, ^{90}Sr, and ^{137}Cs was determined in placental tissues of women from a city of the northern Urals. The data were used to estimate the migration of ^{90}Sr and ^{137}Cs through the placental barrier into the fetus. The kinetics of distribution of ^{90}Sr, ^{137}Cs, Ca, and K in the placenta and fetal tissues is discussed and it is concluded that the content of ^{90}Sr and ^{137}Cs in the placenta may be used as a method of indirect dosimetry of neonates. (HLW)

ANIMALS

REFER ALSO TO CITATION(S) 26548

26649 (EMSL-LV—539-6) **Food habits and radionuclide tissue concentrations of Nevada desert bighorn sheep, 1972—1973.** Brown, K.W.; Smith, D.D.; Bernhardt, D.E.; Giles, K.R.; Helvie, J.B. (Environmental Protection Agency, Las Vegas, Nev. (USA)). Jun 1976. Contract AT(26-1)-539. 29p. Dep. NTIS $4.00.

The botanical composition of the diet and radionuclide content of selected tissues of desert bighorn sheep (Ovis canadensis nelsoni) collected during the 1972 and 1973 hunting seasons were determined by analyzing rumen contents, and lung, liver, kidney, and bone tissues. Botanical examination of the rumen contents showed that grass exceeded 50 percent of the diet of 10 to 14 animals collected in 1972 and 12 of 18 animals collected in 1973. Desert needlegrass (Stipa speciosa), Indian rice grass (Oryzopsis hymenoides), and squirrel tail (Sitanion hystrix) were the major grasses utilized. The dominant shrub species consumed included the joint firs (Ephedra viridis) and (Ephedra nevadensis), Mohave yucca (Yucca schidigera), and cliff rose (Cowania mexicana). With the exception of potassium-40, gamma-emitting radionuclides were not detected in desert bighorn sheep tissue. The tritium levels reported were within environmental levels. Strontium-90 levels averaged 4.9 and 4.1 pCi/gram of bone ash for 1972 and 1973, respectively, continuing the downward trend observed in recent years. Uranium levels were similar to those reported from cattle grazing the same general geographic areas. The daily consumption for one year of 500 grams of liver containing the highest levels of plutonium and uranium would result in a dose to the human bone, the tissue expected to receive the highest dose, of approximately 1 mrem/year. This is less than 1% of the radiation protection guides for the general population.

26650 (ORNL—5160) **Toxicity of uranium and plutonium to the developing embryos of fish.** Till, J.E.; Kaye, S.V.; Trabalka, J.R. (Oak Ridge National Lab., Tenn. (USA)). Jul 1976. Contract W-7405-eng-26. 193p. Dep. NTIS $7.75.

Thesis.

The radiological and chemical toxicity of plutonium and uranium to the developing embryos of fish was investigated using eggs from carp, Cyprinus carpio, and fathead minnows, Pimephales promelas. Freshly fertilized eggs were developed in solutions containing high specific activity ^{239}Pu or ^{233}U or low specific activity ^{244}Pu, ^{235}U, or ^{238}U. Quantitative tests to determine the penetration of these elements through the chorion indicated that plutonium accumulated in the contents of carp eggs reaching a maximum concentration factor of approximately 3.0 at hatching. Autoradiographs of 16 μ egg sections showed that plutonium was uniformly distributed in the egg volume. Uranium localized in the yolk material, and the concentration factor in the yolk sac remained constant during development at approximately 3.3. Doses from ^{238}Pu which affected hatchability of the eggs were estimated to be 1.6×10^4 rads and 9.7×10^3 rads for C. carpio and P. promelas, respectively; doses from ^{233}U were 1.3×10^4 rads for C. carpio and 2.7×10^3 rads for P. promelas. A greater number of abnormal larvae than in control groups was produced by ^{238}Pu doses of 4.3×10^3 rads to carp and 5.7×10^2 rads to fathead minnows; 3.2×10^3 rads and 2.7×10^2 rads were estimated from ^{233}U. Eggs that were incubated in 20 ppM ^{244}Pu did not hatch. This mortality may have been the result of chemical toxicity of plutonium. Concentrations of 60 ppM of ^{235}U and ^{238}U did not affect egg hatching. Based on these data, concentrations in fish eggs were calculated for representative concentrations of uranium and plutonium in natural waters and the corresponding dose levels are below those levels at which observable effects begin to occur.

26651 (ERDA-tr—146, pp 191-195) **Influence of age and complexones on the absorption of curium-244 from the gastrointestinal tract of rats.** Semenov, A.I.; Moskalev, Yu.I. 1975. Translated from Radiobiologiya; 15: No. 5, 780-783(1975).

In Radiobiology.

Curium-244 was administered orally to young and adult rats and one hr later they were given DTPA, EDTA, and sodium citrate. Four days later the rats were killed and the content of the radionuclide in the organs was determined. From the material presented it follows that with increasing age of the animals, the absorption of curium decreases. At the same time, the use of various complexes does not change the ratio in the values of the resorption of ^{244}Cm from the gastrointestinal tract of rats of different ages. In the case of penetration of the isotope into the gastrointestinal tract, peroral administration of DTPA, EDTA, and sodium citrate increases the absorption of ^{244}Cm chloride by 3- to 20-fold, and the deposition in the organs and elimination with the urine. The data obtained indicate the need for cautious use of complex formers in the case of intragastric penetration of the isotope.

26652 (ERDA-tr—146, pp 203-204) **Study of the physicochemical state of plutonium-239 in the system of citrate solution: blood.** Shvydko, N.S.; Popov, D.K.; Rushonik, S.I.; Vorozhtsova, L.N. (Leningrad Scientific Research Inst. of Radiation Hygiene). 1975. Translated from Radiobiologiya; 15: No. 5, 788-790(1975).

In Radiobiology.

The forms of ^{239}Pu in the blood of rats following intraperitoneal administration of the citrate were studied. The results show that when ^{239}Pu penetrates into the blood of rats, 95 percent of the element is converted to a protein-bound form (chiefly to a plutonium-transferrin compound), and about 5 percent of the ^{239}Pu is in a compound with low-molecular-weight addends of the blood serum. The specific radioactivity of transferrin decreases 34-fold during the first seven days, which determines the rate of elimination of ^{239}Pu from the blood.

THERMAL EFFECTS

REFER ALSO TO CITATION(S) 26551

INVERTEBRATES

REFER ALSO TO CITATION(S) 26597

CHEMICALS METABOLISM AND TOXICITY

MICROORGANISMS

REFER ALSO TO CITATION(S) 26580, 26581

PLANTS

REFER ALSO TO CITATION(S) 26471

26653 (COO—1358-15) **Cycling of ^{36}Cl labeled DDT in natural systems. Technical progress report.** Peterle, T.J. (Ohio State Univ. Research Foundation, Columbus (USA)). 21 May 1976. Contract E(11-1)-1358. 11p. Dep. NTIS $3.50.

Data are reported on the cycling of ^{36}Cl-labeled DDT in an old field ecosystem. Data are included on the content of DDT retained in samples of soil, plants, invertebrates, and tissues of small mammals. The body burden of DDT in both earthworms and slugs decreased during the six-year period whereas that of isopods increased, indicating that the food chain sources of the compound differ among soil invertebrates. (CH)

26654 (ORNL-tr—2948) **Dynamics of free and bound amino acids in leaves of trees and shrubs under conditions of coke oven gas production.** Kozyukina, Zh.T.; Obraztsova, V.I. Translated from *Ukr. Bot. Zh.*; **30**: No. 3, 332-339(1973). 12p. Dep. NTIS $4.00.

The composition of amino acids was studied in leaves of gas-resistant (Ligustrum vulgare and Ulmus pinnato-ramosa Dieck) and non-gas resistant species of plants by paper chromatography. A change was established in the direction of nitrogen metabolism: the gas-resistant species are characterized by a higher content of free and bound amino acids.A higher content of specific amino acids (proline, serine, glycine, threonine, valine) might be connected with their protective role from the effect of the industrial environment. A part of sulfur compounds absorbed by the leaves was metabolized, due to which the amount of sulfur-containing amino acids, (cystine, cysteine, methionine) is likely to increase. (auth)

INVERTEBRATES

REFER ALSO TO CITATION(S) 26520, 26653

VERTEBRATES

REFER ALSO TO CITATION(S) 26651, 26653

26655 (UR—3490-815) **Early methylmercury signs revealed in visual tests.** Evans, H.L. (Rochester Univ., N.Y. (USA)). 1975. 21p. (CONF-7510110—1). Dep. NTIS $3.50.

From International conference on heavy metals in the environment; Toronto, Ontario, Canada (27 Oct 1975).

Since overt signs of methylmercury poisoning seem to reflect damage to the central nervous system, the present study employed behavioral tests suited for repeated measurement during a long exposure and recovery period. The most prominent early signs in monkeys involve sensory impairment. Of these, visual deficits have been the most readily quantified. Reduced sensitivity to extremely dim light could be measured many weeks prior to the appearance of overt signs. Deficits in skin senses and intention tremor also were early signs. Additional signs were described in the temporal progression, from the earliest signs through severe intoxication. With dose and blood mercury concentration held constant, the number and severity of signs progresses as a function of duration exposure.

26656 **α-methylphenylalanine, a new inducer of chronic hyperphenylalaninemia in suckling rats.** Greengard, O.; Yoss, M.S.; Del Valle, J.A. (Deaconess Hospital, Boston). *Science;* **192**: No. 4243, 1007-1008(4 Jun 1976).

α-Methylphenylalanine reduces the phenylalanine hydroxylase activity of rat liver by 75 percent. Daily injections of this substance (plus phenylalanine) into rats from the 3rd to 15th day of age had no obvious toxic effects, and maintained a plasma concentration of phenylalanine comparable to that of phenylketonuric subjects.

MAN

REFER ALSO TO CITATION(S) 26451

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 26260, 26494

26657 (ERDA—76-45-5) **Reported Significant Observation (RSO) studies.** Eicher, R.W. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Mar 1976. Contract E(10-0)-1375. 23p. (SSDC—5). Dep. NTIS $4.00.

The Reported Significant Observation (RSO) study, as used in the field of safety, is an information-gathering technique which uses employee-participants to describe situations they have personally witnessed involving good and bad practices and safe and unsafe conditions. This information is utilized in the risk assessment process by helping to monitor the presence of hazards and thereby facilitate their elimination and hopefully prevent their existence in future operations and designs. While capable of playing an integral part in the process, RSO should not be expected to stand alone as the only risk assessment program element. RSO was formally recognized as a significant hazard reduction tool during the development of the Management Oversight and Risk Tree (MORT) program for the U. S. Atomic Energy Commission. The Energy Research and Development Administration (ERDA) has, in turn, adopted MORT for its system safety program, and this has resulted in RSO being brought to the forefront as a modern and viable technique to be considered for possible application in all ERDA contractor safety programs. The RSO flow process is described and examples of introductory material and forms used in the questionnaire approach to RSO studies are included. (CH)

26658 (PB—241903) **Preliminary evaluation of commercially available laser protective eyewear. Technical report, 1971—75.** Envall, K.R.; Coakley, J.M.; Peterson, R.W.; Landry, R.J. (Bureau of Radiological Health, Rockville, Md. (USA)). Mar 1975. 41p. (DHEW/FDA—75-8026). NTIS $3.75.

Preliminary data are presented for 17 laser protective eyewear types; eight were intended to provide protection against argon-ion laser radiation, and nine were intended to provide protection against neodymium-YAG laser radiation. Both lens and frame materials were exposed to the direct CW laser beam at increasing power density values up to 12 W/sq cm. The eyewear test systems, structural changes in the materials, and observations on eyewear labeling are described. (GRA)

26659 (ORNL-tr—4103) **Dust explosions in agricultural hot-air drying equipment.** Beck, G. Translated by R.G. Mansfield from *Agrartechnik;* **25**: No. 3, 139-141(1975). 7p. Dep. NTIS $3.50.

Two dust explosions of moderate to great severity which occurred in the M 804 dryer prompted a discussion of such explosions and, with these as a starting point, a consideration of the general problems of protection in dust explosions in this dryer. The M 804 dryer is a manually controlled dryer used in drying green fodder and chopped or sliced root and tuber crops. (CH)

GEOSCIENCES

REFER ALSO TO CITATION(S) 26424

26660 (LA—6335-PR) **Geosciences at Los Alamos Scientific Laboratory (LASL). Progress report, July 1—December 31, 1975.** Eichelberger, J.C. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). May 1976. Contract W-7405-eng-36. 65p. Dep. NTIS $4.50.

Research in the geosciences at LASL is focused primarily on the problem of understanding processes operating in the hot areas of the earth's crust, and the closely related applied problem of using the hot, dry rock of these regions as a source of geothermal energy. These studies include mass and heat transfer in the crust and upper mantle, phases in crust and upper mantle rocks, near surface and surface behavior of magma (including eruption phenomenology), rock-water interaction at magmatic to surface temperatures, seismology, advanced drilling techniques applicable to hot rocks, geology and geophysics of the Fenton Hill geothermal experiment site, and evaluation of future sites. Many of the programs described here have begun to apply LASL's vast analytical and computational facilities to obtain solutions to major problems in the earth sciences.

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 25490

26661 (NVO—1253-7) **Empirical method for simulation of water tables by digital computers.** Carnahan, C.L.; Fenske, P.R. (Nevada Univ., Reno (USA). Desert Research Inst.). Sep 1975. Contract AT(29-2)-1253. 37p. Dep. NTIS $4.00.

An empirical method is described for computing a matrix of water-table elevations from a matrix of topographic elevations and a set of observed water-elevation control points which may be distributed randomly over the area of interest. The method is applicable to regions, such as the Great Basin, where the water table can be assumed to conform to a subdued image of overlying topography. A first approximation to the water table is computed by smoothing a matrix of topographic elevations and adjusting each node of the smoothed matrix according to a linear regression between observed water elevations and smoothed topographic elevations. Each observed control point is assumed to exert a radially decreasing influence on the first approximation surface. The first approximation is then adjusted further to conform to observed water-table elevations near control points. Outside the domain of control, the first approximation is assumed to represent the most probable configuration of the water table. The method has been applied to the Nevada Test Site and the Hot Creek Valley areas in Nevada. (auth)

26662 (NVO—1253-8) **Water table mapping user's manual.** Carnahan, C.L. (Nevada Univ., Reno (USA). Desert Research Inst.). Jan 1976. Contract AT(29-2)-1253. 89p. Dep. NTIS $5.00.

Procedures are given for use of an empirical water-table mapping routine utilizing the CDC 6400 digital computer located at the University of Nevada System's Computer Center. Detailed instructions are provided for the program sequences to be used in initial simulation of a water table and in updating an existing simulation.

26663 (INEL-TR—5) **Helium reveals the secret of the Earth's interior.** Eremeev, A.N.; Yanitskii, I.N. Translated from *Priroda;* No. 1, 22-33(1975). 28p. Dep. NTIS $4.00.

Applications of He surveying as a method for deep geological mapping of the Earth crust and the indirect forecasting of many types of endogenetic ore deposits are discussed. Experiments showed that the best phase for He mapping appears to be the liquid phase in samples of subterranean water taken from the first tens of meters of the water table. The method has been used for the evaluation of water resources and as an indicator of multiple processes hidden in the rock strata. (CH)

GEOPHYSICS

REFER ALSO TO CITATION(S) 26669

GEOPHYSICAL SURVEY METHODS

26664 **Method of seismic surveying by extracting and displaying seismic properties.** Quay, R.G. (to Petty-Ray Geophysical, Inc.). US Patent 3,899,768. 12 Aug 1975. Filed date 11 Jul 1973. vp.

Various properties of seismic waves such as normalized energy, peak frequency, or interval velocity are extracted with a computer from a seismic section and displayed in one form as a pair of envelopes about the mean time of a specified reflection interval. The upper envelope shows the magnitude of the seismic property in a time zone and the lower enevelope gives the ratio of the magnitudes in the same and the next later time zones.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

26665 (GJO—6344) **Survey and critique of quantitative methods for the appraisal of mineral resources. Progress report.** Harris, D.P. (Arizona Univ., Tucson (USA). Dept. of Mining and Geological Engineering). 11 Mar 1976. Contract AT(05-1)-16344. 648p. Dep. NTIS $16.25.

Two major categories of appraisal methods (models) for regional mineral resources are identified by virtue of the manner in which mineral endowment is treated in the appraisal: implicit and explicit models. Implicit models do not identify nor specify the mineral endowment model. Mineral resources are inferred to exist as required to fulfill economic or secular relationships. Econometric models of mineral supply and Hubbert's time-rate trend projection are varieties of implicit models. Explicit mineral resource models separate the economic and endowment models and state the endowment model explicitly. Explicit models describe mineral endowment as a function of some physical aspect of the earth's crust, such as geology, volume of rock, density of mineral occurrences, and crustal abundance of an element. Economic factors are introduced subsequent to the appraisal of endowment either as an explicit model which interacts with the deposits inferred by the endowment model, or as a simple adjustment made directly on some aggregate measure of endowment.

26666 (LA-UR—76-1399) **Stishovite: a comparison of shock compression data with static compression and ultrasonic data.** Olinger, B.W. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 17p. (CONF-760716—1). Dep. NTIS $3.50.

From Seminar on high pressure research applications in geophysics; Honolulu, Hawaii, United States of America (USA) (6 Jul 1976).

The ultrasonic and static compression data for stishovite were transformed to shock and particle velocities and compared with the higher pressure shock compression data for α-quartz. Using the transformation scheme described in the text, good agreement is found between the shock data and stishovite zero pressure moduli ranging from $K_0 = 300$ GPa, $K_0' = 3$ to $K_0 = 250$ GPa, $K_0' = 6$. (auth)

26667 (LA-UR—76-1408) **Compression studies of forsterite (Mg_2SiO_{33}).** Olinger, B.W. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 18p. (CONF-760716—2). Dep. NTIS $3.50.

From Seminar on high pressure research applications in geophysics; Honolulu, Hawaii, United States of America (USA) (6 Jul 1976).

From hydrostatic high pressure, x-ray diffraction studies of forsterite, Mg_2SiO_4, and enstatite, $MgSiO_3$, zero pressure isothermal bulk moduli and their pressure derivatives were determined.

26668 (SAND—76-0005) **Compression wave studies in Blair dolomite.** Grady, D.E.; Hollenbach, R.E.; Schuler, K.W.; Callender, J.F. (Sandia Labs., Albuquerque, N.Mex. (USA); New Mexico Univ., Albuquerque (USA)). Feb 1976. Contract AT(29-1)-789. 70p. Dep. NTIS $5.50.

Dynamic compression wave studies have been conducted on Blair dolomite in the stress range of 0-7.0 GPa. Impact techniques were used to generate stress impulse input functions, and diffuse surface laser interferometry provided the dynamic instrumentation. Experimental particle velocity profiles obtained by this method were coupled with the conservation laws of mass and momentum to determine the stress-strain and stress-modulus constitutive properties of the material. Comparison between dynamic and quasistatic uniaxial stress-strain curves uncovered significant differences. Energy dissipated in a complete load and unload cycle differed by almost an order of magnitude and the longitudinal moduli differed by as much as a factor of two. Blair dolomite was observed to yield under dynamic loading at 2.5 GPa. Below 2.5 GPa the loading waves had a finite risetime and exhibited steady propagation. A finite linear viscoelastic constitutive model satisfactorily predicted the observed wave propagation. We speculate that dynamic properties of preexisting cracks provides a physical mechanism for both the rate dependent steady wave behavior and the difference between dynamic and quasistatic response.

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

26669 (N—75-31964) **The space activities of Spain.** Panduro, D.L.P. Translated from *Ing. Aeronaut. Astronaut.;* **26**: 53-74(1974). 52p. (NASA-TT-F—16545). NTIS $4.25.

One part of the Spanish space program is related to the installation and operation of ground stations in accordance with international agreements. These stations have participated in space missions of NASA, CNES, and ESRO. A description of space activities conducted during the period from 1968 to 1973 is presented, giving attention to studies of the neutral atmosphere, the ionosphere, cosmic radiation, astrophysics, radio astronomy, geophysics, geodetics and other activities, including the determination of meteorite age and the analysis of lunar materials provided by NASA. Technological activities are considered, taking into account the satellite INTASAT and two sounding rockets. Industrial activities are discussed along with international relations and contributions of Spain to the European space program. (auth)

STARS

26670 **Gas dynamics of semidetached binaries. II. The vertical structure of the stream.** Lubow, S.H.; Shu, F.H. (University of California, Berkeley). *Astrophys. J., Lett.;* **207**: No. 1, L53-L55(1 Jul 1976).

We consider the three-dimensional dynamics of the stream in semidetached binaries undergoing Roche lobe overflow. We generalize the results of an earlier communication to include the dynamical effects in the direction perpendicular to the orbital plane. We find that the scale height of the stream characteristically exceeds its corresponding hydrostatic value by a significant factor because the inertia of the gas prevents it from responding instantaneously to the changing gravitational field. This effect is important for the interpretation of the observations relating to stream-disk impact in cataclysmic variables and in binary X-ray sources of low total mass. (AIP)

QUASI-STELLAR, RADIO, AND X-RAY SOURCES

REFER ALSO TO CITATION(S) 26670

SOLAR PHENOMENA

REFER ALSO TO CITATION(S) 26684

26671 (AD-A—016490) **Brightness temperatures and polarizations of solar active regions at 3.8 cm: theory and observations. Final report, 1 Sep 1972—30 Jun 1975.** Papagiannis, M.D.; Kogut, J.A. (Boston Univ., Mass. (USA). Dept. of Astronomy). Sep 1975. Contract F19628-73-C-0058. 158p. (SER-II-NO—59). NTIS $6.25.

Extensive observations (230 hours in 1973 and 1974) of right and left circularly polarized emission from solar active regions were carried out at 3.8 cm with the 120 ft Haystack antenna, which at this frequency has a resolution of about 4.4 arc minutes. The purpose of these observations was to study the changes in brightness temperature and polarization before flare activity in the hope of recognizing characteristic patterns which could be used as warning signals in the forecasting of major solar flare events. (GRA)

26672 (AD-A—016567) **Solar radio studies at Manila Observatory. Final report, 1 Jan 1973—30 Jun 1975.** Badillo, V.L.; Salcedo, J.E.; Gallardo, E.R. (Manila Observatory (Philippines)). 31 Jul 1975. Contract F19628-73-C-0035. 8p. NTIS $3.25.

Distribution studies of flares, cm and dam radio bursts in the period 1970—72 show an eastern hemisphere preference by dekametric source sites. (GRA)

26673 (COM—75-50193-368-1/SL) **Solar—geophysical data number 368. Part I (prompt reports). Data for March 1975—February 1975. Explanation of data reports issued as number 366 (supplement) February 1975.** Leighton, H.I. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Apr 1975. 107p. (SGD—368(Pt.1)). Paper copy available from National Climatic Center, Attn: Publications. Federal Bldg., Asheville, N.C. 28801. Subscription $34.50/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.40/copy for either part; $1.30 for extra issue.

See also COM—75-50193-368-2.

The bulletin gives various statistical and pictorial solar and geophysical data for the period February—March, 1975. The following aspects of solar activity are explored: Daily solar indices, solar flares, solar radio waves, solar wind measurements, solar x-ray radiation, and solar proton monitoring. Other topics include: Alert period, spacecraft observations, inferred IP magnetic field polarities, sudden ionospheric disturbances, cosmic rays, geomagnetic indices, and radio propagation indices. (GRA)

26674 (COM—75-50193-368-2/SL) **Solar—geophysical data number 368. Part II (comprehensive reports). Data for September 1974—October 1974 and miscellanea. Explanation of data reports issued as number 366 (supplement) February 1975.** Leighton, H.I. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Apr 1975. 65p. (SGD—368(Pt.2)). Paper copy available from National Climatic Center, Attn: Publication. Federal Bldg., Asheville, N.C. 28801. Subscription $34.50/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.40/copy for either part; $1.30 for extra issue.

See also COM—75-50193-368-1.

The bulletin gives a comprehensive list of various solar and geophysical data for the period September—October, 1974. The three main categories are solar flares, solar radio waves, and magnetograms of geomagnetic storms. The following aspects of solar flares are explored: Confirmed solar flares, flare indices, unconfirmed solar flares, and no-flare-patrol charts. Data on solar radio waves include worldwide outstanding occurrences at fixed frequencies. A miscellaneous section contains x-ray spectroheliograms, OSO-5 data for January 1975. (GRA)

26675 (N—75-22242) **The solar elogation distribution of low frequency radio bursts.** Kaiser, M.L. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Apr 1975. 18p. (NASA-TM-X—70883; X—693-75-99). NTIS $3.25.

Submitted for Publication.

Over 500 days of low frequency (less than 5 MHz) radio observations from the IMP-6 spacecraft were accumulated to produce a two dimensional map (frequency versus elongation) of solar type III burst occurrences. This map indicates that most solar bursts are emitted at the second harmonic of the plasma frequency rather than the fundamental. The map also shows that the solar wind electron density varies. (auth)

GALAXIES

26676 (N—75-30953) **Detection of the O III 88.16μ line in M17.** Ward, D.B.; Gull, G.; Harwit, M. (Cornell Univ., Ithaca, N.Y. (USA)). 1975. Contract NGR-33-010-146. 9p. (NASA-CR—143366). NTIS $3.25.

The detection of a predicted transition, the fine structure line of O III at 88.16 microns in the H2 region M17, was reported. Line intensity was measured at 2.2 x 10^{15}. (auth)

COSMOLOGY

26677 (RRK—74-21) **On the average effect of a highly turbulent gravito-hydrodynamic field in the hadron era of the universe, 2. Consideration of dissipative processes.** Nariai, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Dec 1974. 26p. INIS.

The previous formalism for dealing with the average effect of a highly supersonic turbulent gravito-hydrodynamic field in the hadron era of the universe is extended so as to take into consideration various dissipative processes in the hadronic substratum. After a phenomenological fixation of the coefficients of bulk viscosity, shear viscosity and heat conduction, it is shown that those dissipative processes have a considerable influence upon the three characteristic mean-value quantities (at the bounce epoch of our regular model-universe) corresponding to metric, velocity and density fluctuations. A possibility of fixing the dissipation coefficients of the hadronic matter under consideration, i.e., the one based on the concept of statistical bootstrap, in a more well-founded manner is also conjectured.

26678 **Graviton production in a Friedmann universe.** Vainer, B.V.; Nasel'skii, P.D. (Rostov State University). *JETP Lett. (USSR) (Engl. Transl.)*; **23**: No. 3, 123-126(5 Feb 1976).

It is shown that gravitons can be produced near a singularity if account is taken of the reaction of the energy of the long-wave potential excitations and vortical excitations on the course of the cosmological expansion in the homogeneous isotropic universe model. (AIP)

26679 **Gravitational-radiation-detector observations in 1973 and 1974.** Lee, M.; Gretz, D.; Steppel, S.; Weber, J. (University of Maryland, College Park, Maryland 20742). *Phys. Rev., D;* **14**: No. 4, 893-906(15 Aug 1976).

Results of observations of the Argonne-Maryland gravitational radiation detectors during the period May 1973—July 1974 are presented. Previously published data are corrected for a computer programming error. For certain continuous periods we observe an excess of coincidences over the accidental ones. The excess is more significant for the algorithm $[(d/dt)(x^2 + y^2)]^2$ than for the algorithm $(dx/dt)^2 + (dy/dt)^2$. This gives information concerning pulse length and spectral character, and implies that published sensitivity calculations are not applicable to these experiments. (AIP)

ATMOSPHERIC PHYSICS

REFER ALSO TO CITATION(S) 26377

AURORAL AND IONOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 26669

26680 (AD-A—010780) **Mode conversion and single mode excitation in the earth-ionosphere waveguide with arbitrary terrestrial magnetic field. Final technical report, 1 Jan—31 Dec 1974.** Ledinegg, E. (Technische Hochschule, Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik). Jan 1975. Contract DAJA37-74-C-1426. 97p. NTIS $4.75.

Continuation of contracts DAJA37-72-C-3796 and DAJA37-71-C-3546. See also report dated Dec 1973, AD—775477.

The present Final Report contains the continuation and extension of investigations on the propagation of electromagnetic VLF waves in polar regions. The extension considered in this report concerns mainly the terrestrial magnetic field. Part I is devoted to general theoretical considerations. It deals with the derivation of a fictitious surface impedance of the plane ionospheric boundary which mimics the influence of the ionosphere on wave propagation through the atmosphere. In Part II the surface impedance derived in Part I is applied to two waveguide models, the plane two-dimensional and the cylindrical model. In Part III the possibilities for suppressing or favoring the excitation of certain modes in the earth-ionosphere waveguide by a suitable antenna array are discussed. (GRA)

26681 (N—75-22979) **Measurements of atmospheric emission spectra in the 8.5 μm to 13.3 μm and 19.0 μm to 26.0 μm regions at high altitudes and various zenith angles. Final report.** Murcray, D.G.; Brooks, J.N.; Kosters, J.J.; Williams, W.J. (Denver Univ., Colo. (USA). Dept. of Physics and Astronomy). Apr 1975. Contract NGR-06-004-131. 65p. (NASA-CR—142726). NTIS $4.25.

A balloon flight was conducted with a sensitive infrared spectral radiometer system in support of the LACATE balloon experiment. The instrumentation aboard the balloon is described along with data reduction techniques. Results obtained during the flight are presented. (GRA)

EFFECTS OF NUCLEAR DETONATIONS

26682 (AD-A—016527) **vlf/lf TE-mode propagation under disturbed ionospheric conditions. Final report, 1 May—30 Jun 1975.** Field, E.C.; Dore, M.A. (Pacific Sierra Research Corp., Santa Monica, Calif. (USA)). Jul 1975. Contract F19628-75-C-0181. 58p. (PSR—504). NTIS $4.25.

The report compares calculated attenuation rates for transverse magnetic (TM) and transverse electric (TE) modes propagating in the earth-ionosphere waveguide. Frequencies from 10 to 50 kHz are considered, and attention is restricted to situations where the fields can be represented in terms of the least-attenuated TM or TE mode. Nine model ionospheres corresponding to conditions caused by widespread high-altitude fission debris are used as inputs to the calculations. Certain of these models are also representative of polar-cap-absorption (PCA) events. The calculations utilize full-wave methods, and account for the vertical inhomogeneity of the ionosphere, the effects of heavy ions, and the curvature of the earth. In addition to the modal attenuation rates, results are given for field-strength height-profiles, plane-wave ionospheric reflection coefficients, and the relative importance of heavy ions vis-a-vis electrons. (GRA)

MAGNETOSPHERIC PHENOMENA

26683 **Observation of the plasma sheet during a contracted oval substorm in a prolonged quiet period.** Lui, A.T.Y.; Akasofu, S.; Hones, E.W. Jr.; Bame, S.J.; McIlwain, C.E. (Geophysical Institute, University of Alaska, Fairbanks, Alaska 99701). *J. Geophys. Res.;* **81**: No. 7, 1415-1419(1 Mar 1976).

This report presents an interesting observation of a substorm which occurred on a contracted oval, with simultaneous particle measurements by Imp 6 (r~11 R/subE/) and ATS 5 (r~6.6 R/subE/) satellites. At the substorm onset, immediate and substantial energization of both protons and electrons in the plasma sheet was observed by the Imp 6 satellite in the midnight sector. This change was accompanied by a strong earthward plasma flow at ~500 km/s for ~12 min. However, no significant mid-latitude positive bays were detected, and no substorm injection of plasma sheet particles was observed by the ATS 5 satellite, located then at ~0130 MLT. This observation indicates that substorms occurring on a contracted oval are accompanied by two of the characteristic substorm changes in the plasma sheet, namely, the energization of the plasma sheet particles and the occurrence of strong plasma flows, but the substorm injection does not necessarily reach the synchronous distance in the midnight sector. Further, it suggests that contracted oval substorms and intense substorms represent the same physical phenomenon, differing only in magnitude. It is also shown that after a prolonged quiet period the average energies of protons and electrons in the near-earth plasma sheet (at ~11 R/subE/) are as low as 2 keV and 100 eV, respectively. (AIP)

26684 (N—75-30991) **Electron plasma oscillations associated with type-III radio emissions and solar electrons. Progress report.** Gurnett, D.A.; Frank, L.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jul 1975. Contracts NAS5-11074;NAS5-11431. 42p. (NASA-CR—143319). NTIS $3.75.

Submitted for Publication.

An extensive study of the IMP-6 and IMP-8 plasma and radio wave data was performed to try to find electron plasma oscillations associated with type-III radio noise bursts and low-energy solar electrons. It is shown that electron plasma oscillations are seldom observed in association with solar electron events and type-III radio bursts at 1.0 AU. For the one case in which electron plasma oscillations are definitely produced by the electrons ejected by the solar flare, the electric field strength is relatively small. Electromagnetic radiation, believed to be similar to the type-III radio emission, is observed coming from the region of the more intense electron plasma oscillations upstream. Quantitative calculations of the rate of conversion of the plasma oscillation energy to electromagnetic radiation are presented for plasma oscillations excited by both solar electrons and electrons from the bow shock. These calculations show that neither the type-III radio emissions nor the radiation from upstream of the bow shock can be adequately explained by a current theory for the coupling of electron plasma oscillations to electromagnetic radiation. (auth)

26685 (TRITA-EPP—75-22) **Mechanisms that may support magnetic-field-aligned electric fields in the magnetosphere.** Block, L.P.; Faelthammar, C.G. (Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Sep 1975. 38p. INIS.

From 16. IUGG General Assembly; Grenoble, France (25 Aug 1975).

To be published in Annales de Geophysique.

It has become common to consider the possibility of large magnetic-field-aligned voltage drops in the magnetosphere and upper ionosphere. Often it is assumed that such voltage drops, if they occur, are supported by anomalous resistivity. It is pointed out in this review, that anomalous resistivity is only one among several proposed mechanisms and that combinations of these may also be important. Five specific mechanisms are reviewed: (1) Differential pitch-angle anisotropy, (2) Thermoelectric effect in the transition region between a hot and a cool plasma, (3) Outward electric current draining a substantial part of the plasmasheet random electron current, (4) Anomalous resistivity and (5) Electric double layers.

26686 (N—75-20417) **Active experiments in space.** Podgornyy, I.M. Apr 1975. Translated from pp 1-62 of Aktivnyy Eksperimenty v Kosmose, Znanie Press, Moscow, 1974. (NASA-TT-F—16219). 48p. NTIS $3.75.

Various physical phenomena induced in the magnetosphere by plasma fluxes and charged particle beams are studied. Specifically the effect of plasma formations on the geomagnetic field, precipitation on particles causing artificial polar lights, and the development of other geophysical phenomena is studied.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

REFER ALSO TO CITATION(S) 26184

BEAMS AND THEIR REACTIONS

26687 **Mechanism for negative-ion production in the surface-plasma negative-hydrogen-ion source.** Hiskes, J.R.; Karo, A.; Gardner, M. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Appl. Phys.;* **47**: No. 9, 3888-3896(Sep 1976).

The system parameters and surface adsorption conditions of the surface-plasma negative-hydrogen-ion source are reviewed. A mechanism is developed for the production of negative ions by incident energetic hydrogen atoms backscattering from a cesiated tungsten surface. The active electronic level during the course of the collision is approximated as the sum of the negative electron affinity of the cesium hydride negative molecular ion and the image potential. The model predicts negative-ion formation for atomic collisions with all alkali-coated surfaces for alkalis from sodium through cesium. In the case of lithium, the model does not apply due to the breakdown of the image potential approximation close to the surface. Negative-ion formation is also expected to occur for incident positive ions which backscatter from the substrate tungsten as neutrals. The energy thresholds for incident atoms are established. (AIP)

26688 **Broadening of projectile x-ray lines in solid targets.** Fortner, R.J.; Matthews, D.L.; Garcia, J.D.; Oona, H. (Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., A;* **14**: No. 3, 1020-1024(Sep 1976).

In this paper high-resolution K x-ray spectra for boron (1 MeV) and neon (90 keV) projectiles moving in solid targets are reported. The x-ray transitions from the moving ions are found to be substantially broadened, compared to gas-target spectral lines. Estimates of the extent of broadening are presented, and physical mechanisms responsible for it are discussed. (AIP)

26689 **Realization of a relativistic mirror: Electromagnetic backscattering from the front of a magnetized relativistic electron beam.** Granatstein, V.L.; Sprangle, P.; Parker, R.K.; Pasour, J.; Herndon, M.; Schlesinger, S.P.; Seftor, J.L. (Naval Research Laboratory, Washington, D. C. 20375). *Phys. Rev., A;* **14**: No. 3, 1194-1201(Sep 1976).

An intense relativistic electron beam has been injected into a cylindrical drift tube containing a counterstreaming electromagnetic wave (f/sub i/ = 9.3 GHz and P/sub i/ = 170 kW). Within a narrow range of axial magnetic field centered at 5 kG, a reflected wave at f/sub s/ ~ 40 GHz was generated by the interaction of the beam with the incident wave. The reflected wave was observed to have a power of several hundred kilowatts (i.e., greater than the power of the incident wave) and a pulse duration on the order of nanoseconds. All observed experimental characteristics (viz. frequency shift, power amplification, pulse duration, and cyclotron resonance) were consistent with a model of reflection from the discontinuity in refractive index that is associated with an electron beam front near cyclotron resonance. This mechanism could be employed in a new class of short-pulse, ultrahigh power, tunable generators at millimeter and submillimeter wavelengths. (AIP)

ATOMIC AND MOLECULAR PROPERTIES

REFER ALSO TO CITATION(S) 26170, 26861

26690 Oscillator strengths of the spectral lines of atomic thulium. Blagoev, K.B.; Komarovskii, V.A.; Penkin, N.P. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **40**: No. 4, 356-358(Apr 1976).

The relative values of the oscillator strengths of thirty-one spectral lines of atomic thulium have been measured by Rozhdestvenskii's method of hooks. The lines originate in transitions from the 4f/sup 13/ $6s^2$ $^2F^o$ /sub 7;2/ ground state of Tm I. Using a high-frequency discharge to populate the lower excited levels of the atomic thulium, relative values of the oscillator strengths of the eighty strongest absorption lines of Tm I were determined by the same method. These lines arise in transitions from the 8771-cm/sup -1/, 13,119-cm/sup -1/, 15,271-cm/sup -1/, 15,587-cm/sup -1/ and 16,456-cm/sup -1/ levels. The relative f number values of spectral absorption lines originating from the 4f/sup 13/$6s^2$ $^2F^o$ /sub 7;2,5;2/ levels of Tm I, which were converted to absolute values with the aid of data on the lifetimes of the excited states of atomic thulium, were obtained by Wallenstein's method of intersecting levels. (AIP)

26691 Radiative widths of Stark components of fine-structure levels of a hydrogen atom. Zon, B.A.; Katsnelson, B.G.; Mitin, Y.N.; Sholokhov, E.I. *Opt. Spectrosc. (USSR) (Engl. Transl.);* **40**: No. 4, 364-366(Apr 1976).

The probabilities of electromagnetic decay of fine-structure states of a hydrogen atom are calculated as a function of the strength of an external constant electric field. (AIP)

26692 Detection of Rydberg states in atomic uranium using time-resolved stepwise laser photoionization. Solarz, R.W.; May, C.A.; Carlson, L.R.; Worden, E.F.; Johnson, S.A.; Paisner, J.A.; Radziemski, L.J. Jr. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Rev., A;* **14**: No. 3, 1129-1136(Sep 1976).

We report the first observation of perturbed and unperturbed Rydberg progressions of atomic uranium. High-lying levels within 1000 cm/sup -1/ of the ionization limit were accessed by time-resolved stepwise excitation using dye laser pulses tuned to resonant transitions. Atoms excited to these states were then photoionized by intense infrared radiation from a pulsed CO_2 laser. The resultant photoion production was monitored. By delaying the infrared ionizing pulse, and thus discriminating against the shorter-lived valence states, we preferentially detected Rydberg levels with principal quantum numbers n exceeding 60. Series convergence yields a value of the ionization limit of 6.1941 +- 0.0005 eV, in fair agreement with the value of 6.1912 +- 0.0025 eV obtained in photoionization studies. Ab initio calculations indicate that the unperturbed series belong to highly excited $5f^{3}7s^{2}np$ and nf configurations. (AIP)

26693 Doppler-free two-photon resonances in the ν_2 bands of /sup 14/NH_3 at high Stark fields. Bischel, W.K.; Jacobs, R.R.; Rhodes, C.K. (Molecular Physics Center, Stanford Research Institute, Menlo Park, California 94025). *Phys. Rev., A;* **14**: No. 3, 1294-1295(Sep 1976).

Additional two-photon resonances have been observed and identified in the ν_2 bands of /sup 14/NH_3 at high Stark fields with the Doppler-free technique. With an excitation energy of 1880.481 cm/sup -1/ provided by two CO_2 10.4-μm laser quanta [P (14) and P (34)] the observed (ν_2, J, K) yields (ν_2', J', K') resonances are identified as (0^+, 4, 4) yields (2^-, 4, 4) and (0^-, 2, 2) yields (2^-, 2, 2). Violation of the parity rule in the former case is induced by the static Stark field. (AIP)

POSITRONIUM, MUONIUM, AND MUONIC AND MESIC ATOMS AND MOLECULES

REFER ALSO TO CITATION(S) 26235

COLLISION PHENOMENA

26694 (UCRL—51805) **SIGHDT: atomic and molecular cross sections for hydrogen isotopes.** Finan, C.A. III. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Jan 1976. Contract W-7405-Eng-48. 16p. Dep. NTIS $3.50.

SIGHDT is a function subroutine for approximating reaction cross sections for hydrogen isotopes. It is available on the OCTOPUS and Controlled Thermonuclear Research (CTR) networks at Lawrence Livermore Laboratory.

26695 (UCRL—52077) **Raman spectroscopic studies of isotopic diatomic molecules and a technique for measuring stable isotope ratios using Raman scattering.** Harney, R.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 May 1976. Contract W-7405-Eng-48. 83p. Dep. NTIS $5.00.

Thesis.

A method for measuring stable isotope ratios using Raman scattering has been developed. This method consists of simultaneously counting photons scattered out of a high-intensity laser beam by different isotopically-substituted molecules. A number of studies of isotopic diatomic molecules have been made. The Q-branches of the Raman spectra of the isotopic molecules $^{14}N^{15}N$ and $^{16}O^{18}O$ were observed at natural abundance in nitrogen and oxygen samples. Comparison of the ratios of the intensities of the Q-branches of the major nitrogen and oxygen isotopic molecules with mass spectrometric determinations of the isotopic compositions yielded scattering cross sections of $^{14}N^{15}N$ relative to $^{14}N^{14}N$ and $^{16}O^{18}O$ relative to $^{16}O^{16}O$. These cross section ratios differ from unity, a difference which can be explained by considering nuclear mass effects on the Franck-Condon factors of the molecular transitions. The measured intensities of the $^{14}N^{15}N$ and $^{16}O^{18}O$ Q-branches provided the baseline data needed to make the previously-mentioned extrapolation. High-resolution (approximately 0.15 cm^{-1}) spectra of the Q-branches of $^{14}N^{14}N$ and $^{16}O^{16}O$ yielded a direct determination of α/sub e/ (the difference between the rotational constant in the ground and first excited vibrational states) for these molecules. The measured values are in excellent agreement with those obtained by other means. Complete Raman spectra (pure rotation, rotation-vibration, and high-resolution Q-branch) were obtained on a sample of pure $^{18}O^{16}O$. Analysis of this data yielded the molecular parameters: the equilibrium internuclear separation r/sub e/, the moment of inertia I/sub e/, and the energy parameters α/sub e/, B/sub e/, and ΔG/sub $^1/_2$/. These are in good agreement with data obtained by microwave spectroscopy.

26696 Excitation energy of the (1s2s2p) ^{4}P/sub o//sub 5;2/ state in lithiumlike aluminum. Mowat, J.R.; Jones, K.W.; Johnson, B.M. (Department of Physics, The City College of the City University of New York, New York, New York 10031). *Phys. Rev., A;* **14**: No. 3, 1109-1113(Sep 1976).

We have used a Doppler-tuned x-ray spectrometer to measure the energy of the 1564-eV photon emitted during the forbidden intercombination decay (1s2s2p) ^{4}P/sub o//sub 5;2/ yields ($1s^2$2s) ^{2}S/sub e//sub 1;2/ in Al/sup +10/. Delayed x rays were observed coming from 25-, 50-, and 75-MeV Al ions a few nanoseconds after they passed through a 20-$\mu g/cm^2$ carbon foil. Li-like and He-like 2p yields 1s transitions were observed, and the triplet and singlet He-like transitions were well enough resolved to permit their use as energy calibration lines. To verify that the 1564-eV photon was emitted by the J = 5/2 component of the ^{4}P term we measured its intensity as a function of time after excitation, and found a mean life that agrees with a previously published measurement. Both the measured excitation energy, 1563.65 +- 0.90 eV, and the measured mean life, 2.71 +- 0.14 nsec, agree with the theoretical values published by Cheng, Lin, and Johnson. (AIP)

ATOMIC AND MOLECULAR THEORY

26697 Effect of relaxation on adiabatic following. Nayfeh, M.H. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., A;* **14**: No. 3, 1304-1307(Sep 1976).

A solution is presented for the damped optical Bloch equations under the excitation of a smooth pulse by first deriving three independent third-order equations of the Bloch vector components. Each equation is reduced to quadratures by assuming that the logarithmic time derivative of the field amplitude is small compared to the Rabi frequency. This results in an approximate summation of the infinite-order time-dependent perturbation in the field amplitude. The relaxation-dependent induced damping of the population inversion is calculated. Also calculated are additional relaxation-dependent contributions to the intensity-dependent refractive index. The time-integrated intensity contribution tends to cause line asymmetry, which becomes, at later times, linear in γ_2 when γ_2 very-much-greater-than γ_1 and zero when $2\gamma_2 = \gamma_1$, where γ_1 and γ_2 are the atomic energy and phase-changing relaxations, respectively. The dependence of the spectral broadening on pulse length, pressure, and length of the sample is discussed. (AIP)

GENERAL FLUID DYNAMICS

26698 (UCID—17175) **ABMAC-arbitrary boundary marker and cell Eulerian hydrodynamic incompressible numerical method.** Garcia, W.J. Jr.; Viecelli, J.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1976. Contract W-7405-Eng-48. 249p. Dep. NTIS $8.00.

This report is intended to be a "user manual" for the Lawrence Livermore Laboratory version of the Eulerian incompressible hydrodynamic computer code ABMAC. The theory of the numerical model is discussed in general terms. The format for

data input and data printout is described in detail. A listing and flow chart of the computer code are provided.

SUPERFLUIDITY

REFER ALSO TO CITATION(S) 26705, 26706, 26708, 26757

26699 Many-body theory of superfluid ^{4}He. Rickayzen, G. (Univ. of Kent, Canterbury, Eng.). pp 53-109 of In Helium liquids. Armitage, J.G.M. (ed.). New York; Academic Press Inc. (1976).

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

Bose-Einstein condensation in liquid ^{4}He is briefly examined, followed by a discussion of ground and excited states of a gas of weakly interacting bosons in the Bogolyubov model. In order to deal with a boson system in which only a small portion of the particles has condensed, perturbation theory is used, beginning with an expansion of the sum over states in terms of the interaction. The case where the system is nonsuperfluid is first considered and modifications due to condensation are later added. Results of exact calculations to check for the consistency of experiments or approximations are stated. Superfluid states of flow, specifically flow in an annulus between two cylinders, are calculated. The Richards-Anderson experiment to detect an ac Josephson effect in liquid ^{4}He is detailed. A section on second quantization techniques is appended. 21 figures, 32 references. (SDF)

26700 Quantum fluid hydrodynamics. Putterman, S. (Univ. of California, Los Angeles). pp 111-126 of In Helium liquids. Armitage, J.G.M. (ed.). New York; Academic Press Inc. (1976).

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

A phenomenological description of superfluidity is presented based primarily on the Landau two fluid hydrodynamics. Quantum theory is introduced with the addition of the Onsager quantization of vorticity condition, and this is applied to rotating He II. Some of the remaining problems are briefly discussed including the problem of the stability of stationary solutions. 16 references. (SDF)

26701 Superfluid film flow. Campbell, L.J. (Los Alamos Scientific Lab., NM). pp 127-174 of In Helium liquids. Armitage, J.G.M. (ed.). New York; Academic Press Inc. (1976).

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

Characteristics of intrinsic and thermal dissipation in superfluid film flow are detailed. Assuming a steady state process, superfluid beaker film flow is examined and the consequences are outlined. Superfluid flow in multiply connected geometries is illustrated with consideration of gravitational flow between bulk fluid reservoirs joined in parallel. Finally, a discussion of film thinning phenomena is presented. 19 figures, 63 references. (SDF)

26702 Superfluidity in restricted geometries. Eggington, A. (Oxford Univ.). pp 175-209 of In Helium liquids. Armitage, J.G.M. (ed.). New York; Academic Press Inc. (1976).

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

One and two dimensional behavior of superfluid ^{4}He are studied. Results for a free Bose gas and other interacting Bose systems are sketched and experimental features are examined, distinguishing three characteristic temperature areas: (1) specific heat maximum, (2) density maximum, and (3) onset of superflow. A detailed description is then given of the specific heat and the variation of the superfluid fraction and transition temperature with system size. Theoretical attempts to understand the reduction of the superfluid fraction below bulk value and the depression of superflow onset are discussed from a Landau approach and using a vortex theory. 66 references. (SDF)

26703 Three lectures on the experimental properties of liquid ^{3}He. Wheatley, J.C. (Univ. of California, San Diego, La Jolla). pp 241-313 of In Helium liquids. Armitage, J.G.M. (ed.). New York; Academic Press Inc. (1976).

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

These lectures constitute an introduction to the experimental properties of liquid ^{3}He. In Part I concepts and experimental results regarding the normal Fermi liquid are presented with emphasis on those items which can be used immediately in understanding the experiments on the newly discovered superfluid phases of ^{3}He. Part II is concerned primarily with a discussion of experiments on thermodynamic properties of the superfluid phases, emphasizing the phase diagram and what is known about both the thermal and static magnetic properties. The superfluid density near T/sub c/ is also discussed together with concepts regarding the possible anisotropy and orientation of the superfluid. Part III discusses experiments on the nuclear spin dynamics as they manifest themselves in a manner peculiar to superfluid ^{3}He. A discussion of superfluid flow in the hydrodynamic transfer of heat is also included. 4 tables, 35 figures, 76 references.

26704 Theory of anisotropic superfluidity in ^{3}He. Anderson, P.W. (Bell Labs, Murray Hill, NJ); Brinkman, W.F. pp 315-416 of In Helium liquids. Armitage, J.G.M. (ed.). New York; Academic Press Inc. (1976).

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

The Fermi liquid properties of ^{3}He which are relevant to consideration of the superfluid phases are summarized using Landau's theory. The Balian—Werthamer formalism is developed and used to investigate various orbital angular momentum states. Low frequency and static phenomena are then studied with analysis of Fermi liquid corrections. A possible feedback mechanism involving spin fluctuations, important in determining the transition temperature, is detailed and is seen to stabilize the A phase. NMR in the phases of ^{3}He is then examined beginning with a derivation of the equations of motion for the spin angular momentum and the anisotropy axes. Superflow properties are discussed in a generalized Ginzburg—Landau approach and a brief survey of complete and rigorous calculations of various collective excitations in ^{3}He is presented. Textures and singularities of the order parameter are considered separately for the A and B phases. 17 figures, 125 references. (SDF)

OTHER QUANTUM FLUIDS

REFER ALSO TO CITATION(S) 26757

26705 Helium liquids. Proceedings of the fifteenth Scottish Universities summer school in physics, Saint Andrews, Scotland, July 21 to August 10, 1974. Armitage, J.G.M.; Farquhar, I.E. (eds.). New York; Academic Press Inc. (1976). 520p. $41.50.

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

Abstracts for 10 sections are announced separately in ERA. (SDF)

26706 Introductory lectures on liquid helium four and three. Chester, G.V. (Cornell Univ., Ithaca, NY). pp 1-52 of In Helium liquids. Armitage, J.G.M. (ed.). New York; Academic Press Inc. (1976).

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

After a review of simple ground state structural properties of liquid ^{3}He and ^{4}He, a review is given of excitations in liquid ^{4}He, emphasizing the phonon-roton spectrum and the excitation spectrum at higher energies and momenta. Next, Bose condensation as it relates to ^{4}He and superfluidity is discussed. Elements of superflow in bulk ^{4}He are examined, focusing on ideal two fluid hydrodynamics, two fluid hydrodynamics with vorticity, stability of superflow and creation of vorticity, and superflow in pores and films. Finally, a brief discussion of recent developments is given. 16 figures, 109 references. (SDF)

26707 Theory of Fermi liquids. Ron, A. (Technion-Israel Inst. of Tech., Haifa, Israel). pp 211-239 of In Helium liquids. Armitage, J.G.M. (ed.). New York; Academic Press Inc. (1976).

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

Properties of a free Fermi gas are reviewed and some aspects of the Fermi gas with interactions are briefly illustrated using the Hartree—Fock corrections to the energy, and the time dependent self-consistent field approach to collective excitations. A phenomenological approach to the equilibrium properties of Fermi liquids is then considered with account taken of quasi particle interactions. Nonequilibrium properties are examined by considering the system when a weak time dependent inhomogeneous perturbation occurs. Included are derivations of kinetic and transport properties. The microscopic derivation of Landau's theory is then reviewed, concentrating on the quasi particle energy and the interaction function. (SDF)

26708 Dilute solutions of ^{3}He in superfluid ^{4}He at low temperatures. Baym, G. (Univ. of Illinois, Urbana). pp 417-471 of In Helium liquids. Armitage, J.G.M. (ed.). New York; Academic Press Inc. (1976).

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

Details of the excitation spectrum of dilute solutions of ^{3}He in ^{4}He are presented, beginning with the properties of one ^{3}He atom in ^{4}He at T = 0. Next, the interactions of ^{3}He in solution at very low temperatures (less than .6 K) are analyzed considering the ^{3}He as a pure Fermi liquid in an inert ^{4}He ether and describable by the Landau-Fermi liquid theory. The role of ^{3}He in modifying phenomena involving excitations of the ^{4}He fluid is then examined. Determination of the effects of superfluid flow on the ^{3}He quasi particles enables calculation of effects of ^{3}He on first sound propagation and effects on other transport properties. 4 figures, 49 references. (SDF)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

REFER ALSO TO CITATION(S) 26730

26709 (COO—1428-433) **Task A annual progress report, June 1, 1975—April 15, 1976.** (Purdue Univ., Lafayette, Ind. (USA)). 1976. Contract AT(11-1)-1428. 33p. Dep. NTIS $4.00.

Experimental research on high energy physics is summarized. A list of publications is included. (JFP)

26710 (COO—1428-434) **Task D annual progress report, 1 June 1975—31 May 1976.** Barnes, V.E.; Carmony, D.D.; Garfinkel, A.F.; Gutay, L.J. (Purdue Univ., Lafayette, Ind. (USA)). 1976. Contract AT(11-1)-1428. 63p. Dep. NTIS $4.50.

Experimental high energy physics is summarized. A list of publications is included. (JFP)

WEAK INTERACTIONS

26711 **Detection of nu-bar/sub e/-e scattering.** Reines, F.; Gurr, H.S.; Sobel, H.W. (Department of Physics, University of California, Irvine, California 92717). *Phys. Rev. Lett.*; **37**: No. 6, 315-318(9 Aug 1976).

The reaction nu-bar/sub e/+e$^-$yieldsnu-bar/sub e/+e$^-$ has been observed using a 15.9-kg plastic scintillation target in a composite plastic-NaI-liquid detector exposed to a nu-bar/sub e/ flux of 2.2 x 10/sup 13/ cm/sup -2/ sec/sup -1/ from an 1800-MW fission reactor. Tests rule out a reactor-associated signal produced by inverse β decay, neutrons, or gamma rays. The measured cross section is consistent with V-A and the Weinberg model with parameter $\sin^2\theta$/sub w/=0.29 +- 0.05. (AIP)

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 26714

26712 (COO—3130TB-215) **Progress report of a research program in experimental high energy physics, September 1, 1975—August 31, 1976.** Shapiro, A.M.; Lanou, R.E. Jr. (Brown Univ., Providence, R.I. (USA)). 1 Jun 1976. Contract E(11-1)-3130. 103p. Dep. NTIS $5.50.

An experimental program in strong interaction physics is carried out using counter-spark chamber techniques and a bubble chamber—hybrid system. The experiments have been and are being performed utilizing the accelerators of the National Laboratories at Argonne, Brookhaven and Batavia. The experiments of the electronic detector-spark chamber group include the following: a search for high mass boson resonances and determination of quantum numbers in antiproton-proton systems; a nucleon-nucleon and meson-nucleon elastic and quasi-elastic scattering experiment at the highest energies; a study of inclusive scattering, with associated multiplicity and pseudo-rapidity distributions, for hadrons on protons to hadrons at incident energies up to 175 GeV; an experiment to study the A-dependence of hadronic inclusive scattering at Fermilab; a search for charged, long-lived, massive particles up to the kinematic limit at Fermilab; and a study of hadronic final states produced by 100-GeV pions in association with direct leptons. The bubble chamber—hybrid system group is primarily engaged in several experiments at the Fermilab. A study of π^-p interactions at 147 GeV/c is completed, and a larger investigation of π^+p, K$^+$p, pp, and π^-p collisions at 147 GeV/c has begun. To the proportional hybrid system has been added a prototype forward gamma detector, enabling the precision measurement of up to 6 photons (3 π^0's and/or eta^0's). Major aspects of multiparticle production using four different projectiles are being pursued. A precision intercomparison of corresponding processes produced by the different projectiles is underway, using identical experimental conditions. A list of publications is included.

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 26712

26713 (LA-UR—76-1197) **Relativistic description of directly interacting pions and nucleons.** Heller, L. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 12p. (CONF-760561—2). Dep. NTIS $3.50.

From International topical conference on meson-nuclear physics; Pittsburgh, Pennsylvania, United States of America (USA) (24 May 1976).

The expected magnitudes of the leading relativistic effects on an off-energy-shell T matrix element are estimated using the Bakamjian—Thomas formulation of relativistic potential theory. For pion-nucleon scattering at medium energy, the two largest corrections are expected to result from the use of relativistic relative momenta rather than nonrelativistic values. The importance of additional terms depends upon the detailed behavior of the T matrix.

26714 **Study of the reaction π^-+dyieldsp+ all with maximum momentum transfer to the proton in the primary momentum interval from 1.68 to 3.28 GeV/c.** Abramov, B.M.; Dukhovskoi, I.A.; Kishkurno, V.V.; Kondratyuk, L.A.; Krutenkova, A.P.; Kulikov, V.V.; Radkevich, I.A.; Tomashchuk, Y.F.; Fedorets, V.S. (Institute of Theoretical and Experimental Physics). *JETP Lett.* (*USSR*) (*Engl. Transl.*); **23**: No. 3, 156-160(5 Feb 1976).

The cross section of the reaction π^-+dyieldsp+ all (with the proton emitted forward) (1) was measured in the interval from 1.68 to 3.28 GeV/c. A rapidly decreasing dependence of the cross section on the primary π^--meson energy was observed, similar to the energy dependence of the reaction π^-+pyieldsp+ all (2). The cross section of the reaction π^-+nyieldsp+ all (3) was determined from the difference of the reactions (1) and (2). (AIP)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

GENERAL

REFER ALSO TO CITATION(S) 26726

26715 (COO—1428-435) **Task B annual progress report, May 1, 1975—April 30, 1976.** (Purdue Univ., Lafayette, Ind. (USA)). 1976. Contract AT(11-1)-1428. 24p. Dep. NTIS $3.50.

Research on theoretical high energy physics is summarized. A list of publications is included. (JFP)

26716 (COO—1545-179) **Pseudoscalar mixing effects on hadronic and photonic decays of the new mesons.** Bolzan, J.F.; Palmer, W.F.; Pinsky, S.S. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1975. Contract AT(11-1)-1545. 18p. Dep. NTIS $3.50.

The mixing of eta, eta', and eta/sub c/ is calculated in a cylinder dominated model and the results are applied to the hadronic decay psi' yields psi eta and a number of photonic decays, using vector meson dominance. The results are in excellent agreement with all experimental data.

26717 (COO—2271-78) **Theoretical high energy physics. Progress report, May 1, 1975—April 30, 1976.** Lee, T.D.; Serber, R. (Columbia Univ., New York (USA). Dept. of Physics). May 1976. Contract E(11-1)-2271. 24p. Dep. NTIS $3.50.

Research on theoretical high energy physics is summarized. A list of publications is included. (JFP)

26718 **Phase transition in the nonlinear σ model in a $(2+\epsilon)$-dimensional continuum.** Bardeen, W.A.; Lee, B.W.; Shrock, R.E. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D*; **14**: No. 4, 985-1005(15 Aug 1976).

We study the phase transition in the nonlinear O(N) σ model in $2+\epsilon$ dimensions. Our analysis is of the continuum theory and does not rely upon the artifice of a lattice. This phase transition occurs at a critical value of the coupling constant λ/sub c/, which is an ultraviolet-stable fixed point of the renormalization group. In the "low temperature" phase the O(N) symmetry is realized nonlinearly with N - 1 massless pions. By solving the theory in the large-N limit, to leading order in 1/N, we show that in the "high temperature" phase the pions gain mass and there appears a new particle, σ, which is a bound state of the π's and is degenerate with them. Furthermore, by a general steepest-descent approximation to the generating functional and by explicit calculations it is shown that this upper phase is fully O(N) symmetric and can be described by a linear σ-model Lagrangian. The unitarity of the theory is demonstrated and analogies with quark confinement in quantum chromodynamics are discussed. We prove the renormalizability of the theory, taking special care to separate infrared and ultraviolet divergences. (AIP)

ELECTROMAGNETIC INTERACTIONS

26719 (N—75-30863) **Transition radiations in x-ray region. Summary report.** George, M.C. (Alabama A and M Univ., Normal (USA). Dept. of Physics and Mathematics). Jan 1975. 28p. (NASA-CR—143381). NTIS $3.75.

The theory of production of radiations in the transoptical region by the passage of high energy charged particles through the interface of two media is discussed. Based on the theoretical model, calculations are made for electrons of selected energy range passing through Mylar. (auth)

26720 **Global signatures of gauge invariance: Vortices and monopoles.** Tze, H.C.; Ezawa, Z.F. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **14**: No. 4, 1006-1020(15 Aug 1976).

A comprehensive topological classification of vortices and their end-point Dirac monopoles is formulated in gauge theories with an arbitrary compact Lie group. By way of homotopy theory, a simple analysis is presented for the global groups U(1), O(3), and SU(2), then SU(N)/Z/sub N/ and SU(N). Finite vortices are achieved through the complementarity of Dirac strings and the nodal lines of the Higgs fields. In general, the varieties of topologically distinct vortices or monopoles are determined solely by the connectivity of the global group, specified by a discrete Abelian fundamental group. The close connection between our work and the Wu-Yang global formulation of gauge fields is pointed out. (AIP)

WEAK INTERACTIONS

26721 **Simplistic weak interaction.** Peaslee, D.C. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Phys. Rev. Lett.;* **37**: No. 6, 384-386(9 Aug 1976).

A phenomenological weak interaction is proposed on the principle of requiring a minimal addition of new elementary fermions. It also has the feature that decay of all charmed particles must show a leptonic component. Various experimental test are suggested. (AIP)

26722 **Low-energy theorems in supersymmetry.** Mainland, G.B.; Takasugi, E.; Tanaka, K. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Phys. Rev., D;* **14**: No. 4, 1065-1071(15 Aug 1976).

Low-energy theorems for the Goldstone neutrino are derived when there are fermion-boson mass degeneracies as in most spontaneously broken supersymmetric Lagrangians. When there is only the photon-neutrino mass degeneracy, we recover the low-energy theorems derived by de Wit, Freedman, and Bardeen. In the framework of a supersymmetric SU(2) direct-product U(1) gauge model, the theorems are illustrated with the aid of an explicit supercurrent and then verified in the tree approximation. (AIP)

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 26677

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

APPLICATIONS TO STRONG INTERACTIONS

26723 **One possibility of explaining the properties of the psi meson in SU (3) symmetry.** Ioffe, B.L.; Smilga, A.V. (Institute of Theoretical and Experimental Physics). *JETP Lett. (USSR) (Engl. Transl.);* **23**: No. 3, 160-163(5 Feb 1976).

By comparing the probabilities of the decays psiyields3π, psiyieldsKK-barπ, and psiyieldsKK-bar eta, it is possible to identify the representation of the SU (3) symmetry group to which the psi meson belongs, and to determine whether this meson is a unitary singlet or the eighth component of a unitary octet. (AIP)

FIELD THEORY

REFER ALSO TO CITATION(S) 26720

26724 (COO—3065-137) **Geometric formulation of electrodynamics and general relativity in discrete space-time.** Weingarten, D. (Rochester Univ., N.Y. (USA). Dept. of Physics and Astronomy). 13 Jan 1976. Contract E(11-1)-3065. 21p. Dep. NTIS $3.50.

Classical electrodynamics is reconstructed in discrete space-time, then combined with Regge's discrete version of general relativity. Quantization using path integrals is considered briefly.

26725 (ORO—3992-265) **Point transformations and renormalization in the unitary gauge. III. Renormalization effects.** Sherry, T.N. (Texas Univ., Austin (USA). Center for Particle Theory). Jun 1976. Contract E(40-1)-3992. 17p. Dep. NTIS $3.50.

An analysis of two simple gauge theory models is continued using point transformations rather than gauge transformations. The renormalization constants are examined directly in two gauges, the renormalization (Landau) and unitary gauges. The result is that the individual coupling constant renormalizations are identical when calculated in each of the above two gauges, although the wave-function and proper vertex renormalizations differ.

26726 **Infrared behavior in non-Abelian theories for forward processes.** Sachrajda, C.T. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Phys. Rev., D;* **14**: No. 4, 1072-1077(15 Aug 1976).

We show, by means of a simple example, that the Bloch-Nordsieck program cannot be applied to non-Abelian theories in an identical manner to quantum electrodynamics. The simple example is single-gluon bremsstrahlung in quark-quark scattering to lowest order in perturbation theory, the cross section for which is found to be quadratically divergent, i.e., $\sim 1/\lambda^2$, where λ is the fictitious gluon mass. Radiation from internal gluon lines is found to contribute to this divergence. Application to the scattering of color-singlet states is discussed. (AIP)

26727 **Gauge invariance in the operator-product expansion in non-Abelian gauge theory.** Lee, C. (Department of Physics, University of Washington, Seattle, Washington 98195). *Phys. Rev., D;* **14**: No. 4, 1078-1099(15 Aug 1976).

Non-gauge-invariant operators appear in addition to manifestly gauge-invariant operators in the operator-product expansion in non-Abelian gauge theories. However, with the help of various Ward-Takahashi identities, it is shown that these operators which are not gauge invariant do not mix with the gauge-invariant operators to all orders in perturbation theory. These "null" operators have vanishing matrix elements in the physical subspace. Accordingly, the null operators may be neglected completely in the operator-product expansion, and the anomalous dimensions of gauge-invariant operators can be found by simply examining the mixing between the gauge-invariant operators if the correct separation between the gauge-invariant operators and the null operators is made. Our discussion is restricted to the light-cone-dominant twist-two operators with arbitrary spin. (AIP)

26728 **Universality, twisted fans, and the Ising phi^4 model.** Dash, J.W.; Harrington, S.J. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Phys. Rev., D;* **14**: No. 4, 1145-1148(15 Aug 1976).

We calculate critical exponents for the Ising phi^4 model using universality in the form of "twisted fans" previously introduced in Reggeon field theory. The universality is with respect to scales induced through renormalization. Exact twists are obtained at $\beta = 0$ in the one-loop calculation for dimension $D = 2$ and 3 with the correlation-length exponent $\nu = 0.75$ and 0.60, respectively. In the two-loop calculation we obtain $\nu \cong 1.32$ and 0.68. however no twists are obtained for the propagator exponent eta, however. The results for the standard two-loop calculations are also presented as functions of a scale. (AIP)

26729 **Static solutions of two-dimensional field theories.** Yee, J.H.; Hagen, C.R. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Phys. Rev., D;* **14**: No. 4, 1156-1158(15 Aug 1976).

A model field theory consisting of a massive Dirac field interacting with a vector meson by means of the interaction Lagrangian L/sub I/ = e (aj/sub u/ + bj/sub u/$_5$) B/sub u/ is studied in a two-dimensional space-time. It is shown that the theory contains a variety of static solutions including (for appropriate values of the parameters a and b) those of the massive Thirring model and the nonlinear σ model. Thus the static solutions of a number of two-dimensional field theories which have been the objects of recent study can be viewed as special cases of a single unified theory. (AIP)

NUCLEAR PHYSICS

REFER ALSO TO CITATION(S) 26374, 26761

26730 (COO—1195-360) **Annual progress report.** (Illinois Univ., Urbana (USA). Dept. of Physics). Apr 1976. Contract E(11-1)n1195. 41p. Dep. NTIS $4.00.

A summary is presented of research progress at the University of Illinois at Urbana, Illinois during the calendar year 1975. Included are listings of personnel, reports on facilities and operations, and a list of publications submitted or published and papers presented during 1975. (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

26731 (LA-UR—76-1183) **Pion-nucleus total cross-section data from LAMPF and BNL.** Cooper, M.D. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 12p. (CONF-760561—5). Dep. NTIS $3.50.

From International topical conference on meson-nuclear physics; Pittsburgh, Pennsylvania, United States of America (USA) (24 May 1976).

New measurements of pion-nucleus total cross sections were made at LAMPF and BNL. The results from LAMPF include measurement of the difference of the rms neutron and proton radii of ^{48}Ca to be 0.08 +- 0.02 and that of ^{18}O to be 0.19 +- 0.02. The BNL measurements provide a new phenomenology on the downshift and spreading of the (3-3) resonance in nuclei from the first data on heavy nuclei. A new technique for handling the Coulomb effects in total cross section measurements is discussed.

26732 Measurement of the spectra of the protons from the C/sup 12/ nucleus and of the target-nucleus mass-number dependence of the inclusive reaction γ+Ayieldsp+..... at a maximum bremsstrahlung energy E/sub gamma//sup max/=1200 MeV. Kuz'menko, V.S.; Mitrofanova, A.V.; Ranyuk, Y.N.; Sorokin, P.V. (Physico-technical Institute, Ukrainian Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **23**: No. 3, 153-155(5 Feb 1976).

We measured the inclusive spectra of the protons in the (γp) reaction on the C/sup 12/ nucleus and the dependence of the proton yield on the mass number of the target nucleus at various angles, at a maximum bremsstrahlung energy E/sub gamma//sup max/=1200 MeV. (AIP)

26733 Fusion cross sections of light heavy-ion systems: Resonances and shell effects. Sperr, P.; Braid, T.H.; Eisen, Y.; Kovar, D.G.; Prosser, F.W. Jr.; Schiffer, J.P.; Tabor, S.L.; Vigdor, S. (Argonne National Laboratory, Argonne, Illinois 60439). *Phys. Rev. Lett.;* **37**: No. 6, 321-323(9 Aug 1976).

The total fusion cross sections for the systems /sup 12/C+/sup 12/C, /sup 18/O+/sup 12/C, and /sup 19/F+/sup 12/C have been measured as a function of bombarding energy and compared with results for other light heavy-ion systems. The presence or absence of oscillations in the fusion excitation function and the overall magnitude of the cross section at high energies appear to depend on the structure of the colliding nuclei. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 26732

26734 Evidence for large rotational-energy contributions to the kinetic energies of products of deep inelastic reactions. Eggers, R.; Namboodiri, M.N.; Gonthier, P.; Geoffroy, K.; Natowitz, J.B. (Cyclotron Institute and Department of Chemistry, Texas AM University, College Station, Texas 77843). *Phys. Rev. Lett.;* **37**: No. 6, 324-327(9 Aug 1976).

Products of the completely damped deep inelastic collisions of 120-MeV /sup 20/Ne with /sup 27/Al have kinetic energies significantly larger than expected to occur from Coulomb repulsion at the time of scission. The contribution to the fragment kinetic energy from rapid rotation of the fissioning system is comparable to the kinetic energy resulting from Coulomb repulsion. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, THEORETICAL

REFER ALSO TO CITATION(S) 26731, 26732

NUCLEAR REACTIONS AND SCATTERING

26735 (BNL—21199) **Using local momentum to disentangle angular distributions.** Fuller, R.C.; Moffa, P.J. (Brookhaven National Lab., Upton, N.Y. (USA)). Mar 1976. Contract E(30-1)-16. 8p. (CONF-760424—15). Dep. NTIS $3.50.

From Symposium on macroscopic features of heavy ion collisions; Argonne, Illinois, United States of America (USA) (1 Apr 1976).

Optical model elastic and DWBA transfer angular distributions are studied by isolating their positive and negative deflection angle components. The local angular momentum of these amplitudes allows isolation of the regions of angular momentum space that are contributing to the different angular regions of the cross sections. This information can be employed to isolate features of the cross sections arising from orbiting, reflection, Coulomb rainbows, nuclear rainbows, Regge poles, etc. Specifically it is shown that the inner contribution to typical heavy-ion forward-angle elastic scattering is in the shadow of the nuclear rainbow and further that transfer angular distributions contain separate inner and outer contributions. Before discussing results, the idea of a "local momentum" is introduced and the decomposition of angular distributions into their positive and negative deflection angle components is briefly described. Results are shown for the reaction ^{60}Ni(^{13}C,^{12}C)^{61}Ni at E = 60.8 MeV and for the elastic scattering of ^{13}C on ^{60}Ni at the same incident energy. (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

26736 (JAERI-M—5997) **Nuclear data for calculation of the decay power of fission products.** Tasaka, K. (Japan Atomic Energy Research Inst., Tokyo). Feb 1975. 106p. (In Japanese). INIS.

For summation calculation of the decay power of fission products many nuclear data are required for each nuclide, including decay constant, decay energy, decay scheme, fission yields and neutron capture cross section. The nuclear data are presented for 1114 nuclides. The unknown data for short-lived nuclides are estimated statistically.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 26732

26737 (BNL-NCS—50503) **Evaluation of neutron cross sections for the krypton isotopes.** Prince, A. (Brookhaven National Lab., Upton, N.Y. (USA)). Aug 1974. 57p. (ENDF—232). Dep. NTIS $4.50.

This report describes the evaluation of these sections, neutron cross section, and related data of the six stable krypton isotopes ($_{36}$Kr$^{78\ 80\ 82\ 83\ 84\ 86}$) for the Evaluated Nuclear Data File (ENDF)B. The very sparse amount of experimental data for both natural and isotopic krypton made it mandatory to carry out the analysis with the use of various nuclear model codes. The evaluation covers all possible neutron induced reactions in the energy range of 10^{-5} ev to 20.0 MeV.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 26738

ENERGY LEVELS AND TRANSITIONS

26738 Gamma-ray decay schemes for ^{93}Kr, ^{93}Rb, and ^{93}Sr. Bischof, C.J. Ames, IA; Iowa State Univ. of Science and Tech. (1975). 153p. University Microfilms Order No. 76-9174.

Thesis (Ph. D.).

A study of the gamma-ray de-excitation following the beta decays of ^{93}Kr, ^{93}Rb, and ^{93}Sr using the TRISTAN on-line separator facility is reported. Gamma-ray singles and gamma-gamma coincidence measurements were made using Ge(Li) detectors. Of the 162 gamma rays observed in the decay of ^{93}Sr, 143, representing more than 99 percent of the total gamma-ray intensity observed, were placed in a level scheme containing 36 levels. For the decay of ^{93}Rb, 243 gamma rays were observed, of which 231 are placed in a level scheme consisting of 74 levels. This again represents a placement of over 99 percent of the total gamma-ray intensity measured. In the case of the ^{93}Kr decay approximately 98.5 percent of the observed gamma-ray intensity has been accounted for

by the proposed level scheme. This results from the placement of 203 of the 217 gamma rays assigned to this decay in a level scheme comprising 56 levels. Beta-branching for these decays were determined from transition intensity balances. Spin and parity assignments were proposed, whenever possible, on the basis of gamma-ray transition probabilities and deduced log ft values. A comparison is made with the available reaction data for the ^{93}Y level scheme. In all cases an attempt has been made to explain some of the levels in terms of the nuclear shell model and decay systematics.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 26732

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

REFER ALSO TO CITATION(S) 26732

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 26732

26739 **Time-dependent quantum treatment of heavy-ion scattering.** Lin, L.; Sherman, A.; Sperber, D. (Rensselaer Polytechnic Institute, Troy, New York 12181). *Phys. Rev. Lett.*; **37**: No. 6, 327-330(9 Aug 1976).

It is shown that using a quantum time-dependent method one can account for the angular distribution in strongly damped collisions between very heavy ions. The theory is appled to the study of the angular distribution of the reaction /sup 84/Kr+/sup 209/Bi at 600 and 700 MeV. (AIP)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

SPONTANEOUS AND INDUCED FISSION

26740 (LA-UR—76-1383) **What happens to the fission process above the 2nd- and 3rd-chance fission thresholds.** Stewart, L.; Howerton, R.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 18p. (CONF-760647—1). Dep. NTIS $3.50.

From Meeting on fast neutron fission cross sections of U-233, U-235, U-238, and Pu-239; Argonne, Illinois, United States of America (USA) (28 Jun 1976).

Although the multiple fission process is important at high neutron energies, most of the evaluations available today do not include these individual fission cross sections or their associated fission spectra. The representations used in the Los Alamos and Livermore libraries are described and calculations compared with 14-MeV integral experiments available on ^{235}U, ^{238}U, and ^{239}Pu. Further work is needed to clearly delineate the specific problems in order to propose unique solutions.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 26741

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 26752

SPONTANEOUS AND INDUCED FISSION

26741 (ANCR—1299) **Status of beta- and gamma-decay and spontaneous-fission data from transactinium isotopes.** Reich, C.W. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1976. Contract E(10-1)-1375. 55p. Dep. NTIS $4.50.

Several categories of β- and γ-related decay data for the transactinium isotopes are assessed in the light of their potential use in applied areas. The status as of August, 1975, of these data is summarized for 142 transactinium nuclides with 228 less than or equal to A less than or equal to 257 by the listing of experimental values and errors where known. Several useful compilations of transactinium-isotope decay data are discussed. Recent developments related to the yields and energy distributions of prompt and delayed neutrons from spontaneous fission are briefly treated. Comments and observations about the interrelation of the important nuclear-data activities of measurement, compilation and evaluation and needs assessment are given. The applications-oriented file of decay data prepared at our laboratory for ENDF/B is discussed. Finally, a summary by G. Rudstam of the status of the OSIRIS work on delayed-neutron energy spectra of individual precursors is included.

26742 (LA-UR—76-1418) **Spin determination of fission resonances.** Keyworth, G.A. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 17p. (CONF-760715—1). Dep. NTIS $3.50.

From International conference on the interactions of neutrons with nuclei; Lowell, Massachusetts, United States of America (USA) (6 Jul 1976).

The present status of available information on the channel quantum numbers for resonance fission and the most urgently needed additional experiments are examined. The role of spin in the ^{235}U + n system is emphasized. The discussion relies heavily on recent alignment measurements and polarization results. (SDF)

NUCLEAR THEORY

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 26748, 26749

NUCLEAR REACTIONS AND SCATTERING

26743 (LA-UR—76-830) **Hydrodynamical aspects of heavy-ion collisions.** Sierk, A.J.; Nix, J.R. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 24p. (CONF-760424—11). Dep. NTIS $3.50.

From Symposium on macroscopic features of heavy ion collisions; Argonne, Illinois, United States of America (USA) (1 Apr 1976).

In the framework of a hydrodynamical model, three important aspects of heavy-ion collisions are investigated: the potential energy of a nucleus as a function of deformation, the dynamical coupling between collective shape modes, and the effect of the transfer of collective energy into single-particle excitations. The dependence of potential energy on shape has the effect of preventing fusion of heavy ions unless the nuclear system can be brought inside its fission saddle point. For increasing mass number A and angular momentum the fission saddle-point shape becomes more compact than a touching-ion configuration, leading to a rapid drop of predicted fusion cross sections in the vicinity of A = 200. For nuclei with A approximately greater than 200, the coupling between collective shape modes increases the kinetic energy needed by colliding ions to coalesce to a compact shape. This increases the energy required for fusion. In addition to exciting collective shape oscillations during heavy-ion collisions, some of the initial kinetic energy is converted into internal single-particle excitation energy. Two possible mechanisms for this conversion are discussed: ordinary (two-body) viscosity, which arises from collisions between individual nucleons, and one-body dissipation, which arises from nucleon collisions with the moving potential wall. Dynamical calculations using either of these dissipation mechanisms reproduce experimental fission-fragment kinetic energies for nuclei throughout the periodic table. Many of the experimentally observed features of strongly damped heavy-ion collisions are reproduced by dynamical calculations using relatively small values of the ordinary two-body viscosity coefficient, although some discrepancies remain. The analogous calculations using one-body dissipation are not yet done. 8 figures, 1 table.

26744 **Nuclear spectroscopy and reactions. Part D.** Cerny, J. (ed.). New York; Academic Press Inc. (1975). 372p. $24.50.

Five chapters on the theoretical analysis of nuclear reactions have been abstracted separately for ERA. (SDF)

26745 **New approaches in resonance reactions.** Robson, D. (Florida State Univ., Tallahassee). pp 179-248 of In Nuclear spectroscopy and reactions. Part D. Cerny, J. (ed.). New York; Academic Press Inc. (1975).

The concept of resonance is discussed in a simplified approach and developments in nuclear resonance theory are classified, with each class being briefly described. A short introduction to time dependent effects recently investigated experimentally via nuclear collisions in crystals is included. A detailed description of nuclear resonance reactions is presented and is meant primarily for research workers in this area. A schematic two-dimensional model is used to illustrate the channel concept. Angular and energy de-

pendence of the nuclear reaction amplitudes are then considered, the former in terms of the j-j coupling scheme, and the latter in terms of the S matrix. 6 figures, 1 table. (SDF)

26746 **Inelastic scattering and charge exchange.** Madsen, V.A. (Oregon State Univ., Corvallis). pp 249-317 of In Nuclear spectroscopy and reactions. Part D. Cerny, J. (ed.). New York; Academic Press Inc. (1975).

A comprehensive and explicit reference on the theory of nuclear inelastic scattering and charge-exchange reactions is presented. The formulation is based primarily on coupled channel equations. The intrinsic coupling matrix is developed for central tensor two-body forces and for spin-orbit forces in a microscopic model as well as for deformed optical and Lane potentials in the collective model. Selected examples of applications of microscopic theory to charge-exchange and inelastic scattering are illustrated. A short discussion of projectile effective interactions is appended. 13 figures, 3 tables. (SDF)

26747 **One- and two-nucleon transfer reactions.** Glendenning, N.K. (Univ. of California, Berkeley). pp 319-344 of In Nuclear spectroscopy and reactions. Part D. Cerny, J. (ed.). New York; Academic Press Inc. (1975).

The simplest form of the DWBA theory is described for (d,p) reactions together with a discussion of the basic assumptions. Improvements of this simple theory which can readily be incorporated into computer programs and are valuable for use in nuclear data analysis are examined. The two-nucleon transfer reactions are illustrated using the (t,p) reaction. 5 figures. (SDF)

NUCLEAR MODELS

26748 **Models of light nuclei.** Harvey, M.; Khanna, F.C. (Chalk River Nuclear Lab., Ont.). pp 3-96 of In Nuclear spectroscopy and reactions. Part D. Cerny, J. (ed.). New York; Academic Press Inc. (1975).

The general problem of what constitutes a physical model and what is known about the free nucleon-nucleon interaction are considered. A time independent formulation of the basic equations is chosen. Construction of the average field in which particles move in a general independent particle model is developed, concentrating on problems of defining the average spherical single particle field for any given nucleus, and methods for construction of effective residual interactions and other physical operators. Deformed shell models and both spherical and deformed harmonic oscillator models are discussed in detail, and connections between spherical and deformed shell models are analyzed. A section on cluster models is included. 11 tables, 21 figures. (SDF)

26749 **Models of heavy nuclei.** Rasmussen, J.O. (Yale Univ., New Haven). pp 97-178 of In Nuclear spectroscopy and reactions. Part D. Cerny, J. (ed.). New York; Academic Press Inc. (1975).

Different forms of the Fermi gas model are examined using both a spherical square well and a cubic square well. The liquid drop model is then considered followed by a discussion of shell models in spherical, spheroidal, and two-center versions. After these descriptions of models with independent motion of nucleons in average fields, the role of nuclear forces in bringing about correlations and departures from independent motion is detailed. Included are pairing models and discussions of nuclear rotational and vibrational motion. 3 tables, 22 figures. (SDF)

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 25792, 26719, 26753

26750 (ORNL/CSD/TM—2) **SWIMS: a small-angle multiple scattering computer code.** Sayer, R.O. (Oak Ridge National Lab., Tenn. (USA)). Jul 1976. Contract W-7405-eng-26. 17p. Dep. NTIS $3.50.

SWIMS (Sigmund and WInterbon Multiple Scattering) is a computer code for calculation of the angular dispersion of ion beams that undergo small-angle, incoherent multiple scattering by gaseous or solid media. The code uses the tabulated angular distributions of Sigmund and Winterbon for a Thomas-Fermi screened Coulomb potential. The fraction of the incident beam scattered into a cone defined by the polar angle α is computed as a function of α for reduced thicknesses over the range 0.01 less than or equal to tau less than or equal to 10.0. 1 figure, 2 tables

NEUTRON INTERACTIONS WITH MATTER

26751 (COO—2280-26) **Computational complexity in multidimensional neutron transport theory calculations. Progress report, September 1, 1975—August 31, 1976.** Bareiss, E.H. (Northwestern Univ., Evanston, Ill. (USA). Technological Inst.). May 1976. Contract E(11-1)-2280. 30p. Dep. NTIS $4.00.

The objectives of the work are to develop mathematically and computationally founded for the design of highly efficient and reliable multidimensional neutron transport codes to solve a variety of neutron migration and radiation problems, and to analyze existing and new methods for performance. As new analytical insights are gained, new numerical methods are developed and tested. Significant results obtained include implementation of the integer-preserving Gaussian elimination method (two-step method) in a CDC 6400 computer code, modes analysis for one-dimensional transport solutions, and a new method for solving the 1-T transport equation. Some of the work dealt with the interface and corner problem in diffusion theory. (RWR)

26752 (COO—2458-9) **Sensitivity of uranium spectra to inelastic matrix perturbation.** Parvez, A.; Becker, M. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA). Dept. of Nuclear Engineering). 1976. Contract E(11-1)-2458. 6p. (CONF-760622—6). Dep. NTIS $3.50.

From American Nuclear Society 1976 annual meeting; Toronto, Ontario, Canada (13 Jun 1976).

The capability for utilizing interactive graphics computing for direct data adjustment has been extended to facilitate studies of inelastic matrices, and has been applied to identify the type of data modification appearing most likely to resolve experiment-theory discrepancies. While this type of investigation does not yield a unique new data set, it does lead to a recommendation that evaluations for new ENDF/B files for uranium emphasize reductions in transfers from the MeV range to low energies.

26753 (FOA-C—20075-A2) **Calculation of neutron and gamma transport at the FOA:type of problems and calculation methods.** Lefvert, T. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Nov 1975. 27p. (In Swedish). INIS.

Protection against the effects of nuclear warfare involves the analysis of the forms of results of a nuclear charge explosion producing neutron and gamma radiation. It brings out problems leading to the calculation of criticality, leakage, and deep transmission. Methods have been developed for various kinds of particle transport problems. Applications to radiation therapy, storage of fissile materials, and fast reactors are discussed. A list (with brief description) of all neutron and gamma transport programmes of the FOA is given.

26754 (INIS-mf—3060) **Scattering of thermal neutrons by the water molecule according to Nelkin's model.** Rosa, L.P. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). [nd]. 78p. (In Portuguese). INIS.

The calculation of the differential cross section for scattering of thermal neutrons by water, taking into account the translational, rotational and vibrational motions of the water molecule, is presented according to Nelkin's model. Some modifications are presented which have been introduced in the original method to improve the results, and an application has been made to reactor physics, by calculating the thermal neutron flux in a homogenous medium containing water and absorber. Thirty thermal energy groups have been used to compute the spectra. Within the limits of error, better agreement has been obtained between theory and experiments by using a modified Nelkin kernel consisting of substituting the asymptotic formulae for the rotational and vibrational motions by more exact expressions, similar to the Buttler model for heavy water.

MEDICAL PHYSICS

DOSIMETRY

26755 (DP—1414) **Calibration of intense ^{60}Co gamma ray sources at the Savannah River Plant.** Bibler, N.E. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). May 1976. Contract AT(07-2)-1. 17p. Dep. NTIS $3.50.

Three different dosimeters were used to calibrate Savannah River Plant ^{60}Co sources having intensities greater than 10^7 rads/hr. These dosimeters are (a) ceric sulfate dissolved in 0.4M H_2SO_4, (b) oxalic acid dissolved in water, and (c) a commercially available nylon film containing a radiochromic dye. Response per unit dose to these dosimeters is independent of radiation intensity at 10^4 to 10^{11} rads/hr. The dosimeters were calibrated at 6.0×10^5 rads/hr with a ^{60}Co source whose intensity was determined with the standard Fricke dosimeter. For the sources at 10^7 rads/hr or

greater, intensities were calculated from slopes of linear plots of dosimeter response versus irradiation time. Individual dose rates varied from 1.0 x 10^7 to 4.6 x 10^7 rads/hr. Each source was calibrated with at least two different dosimeters. Relative standard deviations varied from 2 to 9 percent. A conservative estimate of the uncertainty in the accuracy of these dosimeters is 10 percent. Of the three dosimeters, the nylon film is easiest to use and is therefore recommended for future calibrations.

SOLID STATE PHYSICS

26756 (COO—3161-37) **Weakly-pinned Froehlich-charge-density-wave condensates: a new, nonlinear, current-carrying elementary excitation.** Rice, M.J.; Bishop, A.R.; Krumhansl, J.A.; Trullinger, S.E. (Xerox Corp., Webster, N.Y. (USA). Webster Research Center; Cornell Univ., Ithaca, N.Y. (USA). Lab. of Atomic and Solid State Physics). Nov 1975. Contract E(11-1)-3161. 11p. Dep. NTIS $3.50.

New, nonlinear, charged elementary excitations are predicted to occur for weakly-pinned Froehlich-charge-density-wave condensates at low temperatures.

26757 **Kapitza conductance.** Challis, L.J. (Nottingham Univ., Eng.). pp 473-495 of In Helium liquids. Armitage, J.G.M. (ed.). New York; Academic Press Inc. (1976).

From 15. proceedings of the Scottish Universities summer school in physics; St. Andrews, Scotland (21 Jul 1974).

An experimental survey of two main types of Kapitza conductance is presented: phonon conductance and magnetic conductance. The former is discussed in terms of an average transmission coefficient defined as the probability that the energy of a phonon in the solid incident on the interface will be transmitted into the liquid. The discussion of magnetic conductance includes consideration of conductance between cerium magnesium nitrate and both liquid and solid ^{3}He. 6 figures, 53 references. (SDF)

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 26046, 26071, 26094, 26115, 26116, 26129, 26138, 26147, 26148, 26149, 26150, 26167, 26168

26758 **A model of flux pinning by grain boundaries in type-II superconductors.** Pande, C.S.; Suenaga, M. (Brookhaven National Laboratory, Upton, New York 11973). *Appl. Phys. Lett.*; **29**: No. 7, 443-444(1 Oct 1976).

A relationship between pinning force F/sub p/ and grain size D in type-II superconductors derived on the basis of interaction of fluxoids with dislocations forming the grain-boundary walls is reported. While confirming approximately the experimentally observed F/sub p/proportional1/D relationship, the theory predicts a peak in F/sub p/ at $a_0/D \cong 0.2$, where a_0 is the lattice constant of the flux line lattice. (AIP)

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

26759 (BNL—21590) **Survey of displacement methods for the plate bending problem.** Scott, L.R. (Brookhaven National Lab., Upton, N.Y. (USA)). Jun 1976. Contract E(30-1)-16. 25p. (CONF-760812—3). Dep. NTIS $3.50.

From US-Germany symposium on finite element analysis; Cambridge, Massachusetts, United States of America (USA) (9 Aug 1976).

Approximation of the classical plate bending problem by finite element displacement methods is considered. The emphasis is on the complications unique to 4th order problems, such as the plate bending problem, that make finite element approximation more difficult than 2nd order problems such as plane stress. The most striking of these is that the polygonal approximation, in the case of a simply supported boundary condition, converges to the wrong answer. The two basic approaches to remedy this in the context of displacement methods are reviewed: alteration of the energy form and modification of the boundary conditions. The ideas presented here are also applicable to the bending portion of some methods for shell analysis. Isoparametric elements are nonconforming for 4th order problems and may also be nonconvergent. The Sabolev norm, a generalized measure of energy, is introduced. Methods of solution other than finite element displacement methods are mentioned briefly. (RWR)

26760 (ORO—3992-266) **Relativistic wave equations without the Velo-Zwanziger pathology.** Khalil, M.A.K. (Texas Univ., Austin (USA). Center for Particle Theory). Jun 1976. Contract E(40-1)-3992. 37p. Dep. NTIS $4.00.

For particles described by relativistic wave equations of the form: (-iGAMMA x delta + m) psi(x) = 0 interacting with an external field B(x) it is known that the "noncausal" propagation characteristics are not present when (1) $GAMMA_0$ is diagonalizable and (2) B(x) = -eGAMMA/sub mu/A/sup mu/(x) (Amar—Dozzio). The "noncausality"difficulties arise for the Rarita—Schwinger spin $^3/_2$ equation, with nondiagonalizable $GAMMA_0$, in minimal coupling (i.e., B(x) = -eGAMMA x A(x)) and the PDK spin 1 equation, with diagonalizable $GAMMA_0$, in a quadrupole coupling (Velo—Zwanziger) where either (1) or (2) of the Amar—Dozzio (sufficient) conditions are violated. Some sufficient conditions are derived and explored where the Velo—Zwanziger "noncausality" pathology can be avoided, even though one, or the other, or both of the conditions (1) and (2) are violated. Examples with both reducible and irreducible wave equations are included.

RELATIVITY AND GRAVITATION

REFER ALSO TO CITATION(S) 26724

MATHEMATICAL PHYSICS

REFER ALSO TO CITATION(S) 26698, 26927

CONTROLLED THERMONUCLEAR RESEARCH

26761 (INIS-mf—3038) **The Nucleus. Annual review of the Science Foundation for Physics and the School of Physics within the University of Sydney.** (Sydney Univ. (Australia). School of Physics; Sydney Univ. (Australia). Science Foundation for Physics). Mar 1975. 24p. INIS.

Research programs are outlined for the following departments: Theoretical Physics, Nuclear Physics, Plasma Physics, Astronomy and Astrophysics.

PLASMA RESEARCH

REFER ALSO TO CITATION(S) 26689

26762 **Asymptotic form of the classical one-component plasma fluid equation of state.** DeWitt, H.E. (University of California, Lawrence Livermore Laboratory, Livermore, California 94550). *Phys. Rev., A;* **14**: No. 3, 1290-1293(Sep 1976).

The Monte Carlo data of Hansen for the internal energy of the classical one-component plasma in the fluid state is found to satisfy accurately a simple functional form, U/NkT = aΓ + bΓ/sup 1;4/ + c, for Γ > 1. The fluid static energy is very close to the bcc lattice energy of the solid, and the fluid thermal energy varies as T/sup 3;4/. Simple and accurate expressions for other thermodynamic functions for the plasma fluid are given. (AIP)

PLASMA CONFINEMENT AND HEATING

REFER ALSO TO CITATION(S) 26821, 26826

26763 (INIS-mf—3041) **Heating and ionization in MHD shock waves propagating into partially ionized plasma.** Bighel, L.; Collins, A.R.; Cramer, N.F.; Watson-Munro, C.N. (Sydney Univ. (Australia). School of Physics). Sep 1975. 5p. INIS.

4 figs.

A model of the structure of MHD switch-on shocks propagating in a partially ionized plasma, in which the primary dissipation mechanism is friction between ions and neutrals, is here compared favourably with experimental results. Four degrees of upstream ionization were studied, ranging from almost complete to very small ionization.

26764 (IPPCZ—188, pp 2-6) **Direct currents produced by hf heating of plasma.** Klima, R. Feb 1974.

In I. Direct currents produced by hf heating of plasma. II. On the angular momentum transferred during electromagnetic energy absorption and emission.

In addition to the well-known diffusion currents, toroidal direct currents arise in h.f. heated plasmas as a result of a momentum transfer from the h.f. field to plasma particles. The estimates of steady-state conditions are given for these currents. Particularly, the possibility of stationary operation of a Tokamak device is analyzed.

26765 (IPPJ—209) **Particle loss from magnetic cusp field.** Namba, C.; Kawamura, T.; Obayashi, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1974. 16p. INIS.

The motion of charged particles in an axially symmetric magnetic field of cusp configuration is studied by means of numerical calculations. A particular attention is paid to a non-adiabatic zone. The computer results are compared with a simplified loss cone model and it is shown that there is a critical value of non-adiabaticity parameter which defines an effective size of the non-adiabatic zone.

26766 (JAERI-M—6171) **Impurity transport in non-axisymmetric toroidal systems.** Tuda, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1975. 11p. (In Japanese). INIS.

Impurity transport in a non-axisymmetric toroidal system (stellarator or Tokamak with field ripples) has been studied. Each ion species is assumed to be collisionless sufficiently to exist trapped particles due to the field ripples. The impurity transport in a non-axisymmetric system is similar to that in the axisymmetric one, i.e. inward diffusion and peaking of the impurity ions are indicated.

26767 (JAERI-M—6178) **The behavior of a fusioning neo-classical tokamak plasma.** Nagami, M. (Japan Atomic Energy Research Inst., Tokyo). Jul 1975. 19p. (In Japanese). INIS.

On the basis of the neo-classical transport theory of a plasma with multiple ion species, the transports of deuteron, triton, and alpha particle are treated, and the behavior of the fusioning plasma of a Tokamak Fusion Test Reactor is examined numerically. Four cases, which are different with each other in the initial ratio of D-T mixture, concentration of high-Z impurity, and injection energy of neutral beam heating, are examined in detail, and the conditions to reach self-sustaining burning states are obtained.

26768 (LA—6393-MS) **Comment on energy deposition in laser-heated plasmas.** Henderson, D.B.; Stroscio, M.A. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1976. Contract W-7405-Eng-36. 4p. Dep. NTIS $3.50.

A simple connection between the x-ray spectrum and the number and energy distribution of suprathermal electrons in laser-heated plasmas has been suggested by Brueckner. This relation is shown to depend sensitively on an inaccurate approximation to an integral occurring in the model.

26769 (MATT—1227) **Some observations of surface conditions in the ATC tokamak.** Cohen, S.A.; Dylla, H.F. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jun 1976. Contract E(11-1)-3073. 23p. Dep. NTIS $3.50.

A surface analysis station has been constructed and installed on the ATC tokamak. Data taken during supplementary heating experiments show rapid contamination of clean metal surfaces by monolayer quantities of carbon and oxygen and ten times smaller quantities of sulfur, chlorine and fluorine. No limiter or liner material is found above the detection limit.

26770 (ORNL/TM—5429) **High beta flux-conserving tokamaks.** Clarke, J.F. (Oak Ridge National Lab., Tenn. (USA)). Jun 1976. Contract W-7405-eng-26. 33p. Dep. NTIS $4.00.

Numerical and analytic studies have shown that plasmas subject to external heating will naturally seek high beta equilibria whose characteristics are determined by flux conservation. These equilibria can be characterized by broad pressure profiles and plasma currents peaked toward the plasma surface. They possess the same q profiles as the low beta equilibria from which the heating commences, and consequently have reasonable stability properties against local MHD modes. These equilibria are naturally non-circular and tend to approximate a D-shape with moderate elongation of roughly one and one-half. The technological requirements for sustaining such equilibria are not extreme. Their confinement characteristics are such that one can contemplate attaining ignition conditions in moderate-size plasmas. The one remaining factor which must be analyzed is the stability of these equilibria to MHD modes. In this regard, there is no reason to suspect difficulty at moderate beta. However, since these equilibria have the capability of attaining arbitrarily high beta as far as the equilibrium of the plasma is concerned, it is important to investigate the limitations imposed on maximum attainable beta by MHD stability theory.

26771 (UCRL—50002-75) **Controlled thermonuclear research. Annual report, July 1974—June 1975.** Harrison, M.A.; McGregor, C.K. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1975. Contract W-7405-Eng-48. 148p. Dep. NTIS $6.00.

Separate abstracts were prepared for the three included sections. (MOW)

26772 (UCRL—50002-75, pp 75-113) **Section 3. Research: theory and computations.** 15 Oct 1975.

In Controlled thermonuclear research. Annual report, July 1974—June 1975.

Agreement between theoretical and experimental results led to increased confidence in linear and quasilinear theory. Advances during the year included a program for studying the magnetic trapping of laser-generated target plasmas, a code for the computation of finite-beta guiding-center equilibria in minimum-B geometry, and a series of Fokker-Planck codes describing classical loss processes. A quasilinear model of the drift-cyclotron loss-cone mode has been developed that agrees very well wit 2XIIB data. Gas-embedded Z-pinches initiated either by a relativistic electron beam or by exploding tubes were the subject of a small exploratory research program.

26773 **Wave propagation and rf assisted confinement in a multiple mirror at the harmonics of the ion cyclotron frequency.** Singh, C.M. Austin, TX; Univ. of Texas (1975). 106p. University Microfilms Order No. 76-14,518.

Thesis (Ph. D.).

This work is devoted to an experimental investigation of the wave propagation characteristics and the rf supplemented confinement enhancement principles of a multiple mirror plasma at the fundamental and second harmonic of the ion cyclotron frequency. Keeping the magnetic field constant, rf power at 5.6 and 11.2 MHz was coupled to a fully ionized plasma with densities of 10^{13} cm^{-3}. Electrostatically shielded and unshielded single turn circular loop antennas concentric with the plasma column were used to couple rf energy to the plasma such that ω greater than Ω/sub ci/ at the point of excitation. Experiments were also done using multiple antennas - up to a maximum of three single turn loop antennas were excited in parallel and in phase from the same rf generator.

26774 **Use of the hydrodynamic effects of densification and heating in order to obtain dense and very dense plasma in a high-power, pulse discharge.** Sultanov, M.A.; Orifshoev, I. *Dokl. Akad. Nauk Tadzh. SSR;* **19**: No. 2, 22-25(1976). (In Russian).

This study describes a method of obtained dense plasma with the use of hydrogasodynamic effect of densification and heating. Studies were carried out by optical chronography and by spectroscopic measurement of the main parameters. It was found that the shock-compressed region of the plasma is a zone of intense light emission bounded on the wall side of the discharge chamber by shock waves, while moving pictures taken perpendicular to this direction consist of light and dark regions of separate plasma bundles. The rate of expansion of the discharge clouds has values of 2, 2.5 and 4 km/sec for increasing discharge capacitance of 200, 600 and 1200 microfarads at a voltage of 3 kV. With increasing discharge power an increase is observed also in the tangent of the angle of slope of separate plasma stria. With increasing discharge energy an increase is observed in the intensity, amount and radii of the emitting rings. The spectra show that along with line radiation the spectrum is also characterized by a strong continuous emission. With increasing wavelength the brightness of the continuous spectrum increases, and it becomes difficult to determine quantitatively the parameters of the dense plasma by means of the usual spectroscopic method. This method of obtaining a dense plasma is suitable for use under laboratory conditions. 7 refs. (SJR)

26775 **Strong interaction of relativistic electron beams with gas and plasma.** Tsytovich, V.N. (AN SSSR, Moscow. Fizicheskij Inst.). *Physica, B, C;* **82**: 141-154(Mar 1976).

From 12. international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The problems of excitation of a new strong turbulent plasma state by intense relativistic beams are discussed. The role of self-accelerating solitons, cavitons and spikons is considered. Modulation instability of relativistic electron beams is shown to differ essentially from known modulational instability. The acceleration of ions and plasma heating by beam plasma interaction and return current are analyzed.

26776 **Magnetic fields for surface containment of plasmas.** Forrester, A.T.; Busnardo-Neto, J. (University of California, Los Angeles, California 90024). *J. Appl. Phys.;* **47**: No. 9, 3935-3941(Sep 1976).

Magnetic fields produced by a periodic array of rectangular bars magnetized perpendicular to their lengths have proven to be

useful boundaries for plasma containment. Convenient formulas are developed for the computation of the magnetic fields for any choice of parameters. These formulas include not only the configuration which has commonly been used, but some alternate arrangements which can be advantageous for certain applications. (AIP)

26777 Straight l=1 equilibrium and stability. Marder, B.M. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Fluids;* **19**: No. 9, 1395-1400(Sep 1976).

The equilibrium and stability of a straight, two-dimensional, l=1 plasma configuration in which no net longitudinal current is allowed to flow on any flux surface has been examined numerically. It is conjectured that equilibria exist and are unique for parameter ranges far in excess of those of physical interest. The δW stability analysis is done in the slow z variation limit and predicts gross modes which are qualitatively and quantitatively similar to the sharp boundary theory. In addition, other modes with higher nodal structure are found but appear to be stable. (AIP)

26778 Preparation of a hot plasma for a high beta tokamak . Marshall, T.C.; Lui, H.C. (Plasma Laboratory, Columbia University, New York, New York 10027). *Phys. Fluids;* **19**: No. 9, 1417-1419(Sep 1976).

The possibility of generating a hot, high density plasma in the high beta tokamak configuration [βapproximately-less-than0.3, q (a) >1] using a turbulent poloidal current to heat the plasma and adjust the magnetic fields is studied. The physical principles underlying this method are discussed, and it is demonstrated, using a numerical simulation, how they may be implemented. (AIP)

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 26379

26779 (JAERI-M—6042) **Scattering measurements in Tokamak type devices.** Matoba, T. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 19p. (In Japanese). INIS.

Theories, experiments and proposals for light scattering in Tokamak type devices are reviewed. Thomson scattering, measuring method of the current density distribution by scattering and resonance fluorescence are summarily described. These methods may be useful for diagnosis of the fusion plasmas. The report may help planning of the measuring apparatus for the fusion plasmas in future.

26780 (JAERI-M—6144) **Electro-magnetic diagnostic system for DIVA.** Kitsunezaki, A.; Shimomura, Y.; Maeda, H.; Tokutake, T.; Nagashima, T. (Japan Atomic Energy Research Inst., Tokyo). Jun 1975. 34p. (In Japanese). INIS.

Design and construction of the electro-magnetic diagnostic system for JFT-2a (DIVA) are described. Problems in the design are indicated, giving the solution for each problem. Some problems are intrinsic in JFT-2a. The means to deal with them are discussed.

26781 (JAERI-M—6166) **Fringe-shift interferometric apparatus for tokamak-plasma diagnostics.** Funahashi, A.; Takahashi, K.; Shimomura, Y.; Kitsunezaki, A.; Nagashima, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1975. 53p. (In Japanese). INIS.

The fringe-shift interferometric apparatus for Tokamak-plasma diagnostics is a 75GHz-band zebra-stripe interferometer to measure the electron densities in non-circular cross-section Tokamak installation, JFT-2a (DIVA). The apparatus is designed to produce five fringe-stripes and capable of detecting down to one-tenth of one fringe-shift. It consists of a KA701A klystron (output 400mW), 75GHz-band microwave circuits, delay lines (total length 17m), collecting lenses for 75GHz-waves, shutters to prevent the lenses from being opaque due to plasma-sputtering, and electronic circuits for producing zebra-stripes. The interferometric apparatus has been used for diagnosis of the JFT-2a plasmas since September 1974; the electron density of about $10^{13}cm^{-3}$ realized in the central region of JFT-2a was confirmed by the apparatus.

26782 (LA-UR—76-965) **Maximum entropy restoration of laser fusion target x-ray photographs.** Brolley, J.E.; Lazarus, R.B.; Suydam, B.R. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 5p. (CONF-760704—2). Dep. NTIS $3.50.

From International conference on image analysis and evaluation; Toronto, Canada (19 Jul 1976).

Maximum entropy principles were used to analyze the microdensitometer traces of a laser-fusion target photograph. The object is a glowing laser-fusion target microsphere 0.95 cm from a pinhole of radius 2×10^{-4} cm, the image is 7.2 cm from the pinhole and the photon wavelength is likely to be 6.2×10^{-8} cm. Some computational aspects of the problem are also considered. (MOW)

26783 (MATT—1191) **Scheme for evaluating T/sub E/T/sub I/ and anti Z by light scattering.** Bretz, N.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Mar 1976. Contract E(11-1)-3073. 15p. (CONF-760128—2). Dep. NTIS $4.00.

From Conference on diagnostics of high temperature plasmas; Knoxville, Tennessee, United States of America (USA) (7 Jan 1976).

When highly ionized impurities are present in a plasma, the scattered spectrum of the major ion species can be distorted in a complicated way. A method is given by which T/sub e/T/sub i/ and anti Z (identical with sigma n/sub j/z/sub j/^{2}/n/sub e/) can be measured which does not require any knowledge of the mass, charge state, or concentration of the impurity species. A generalization of the Salpeter approximation for the integrated cross-section is proven. The result is that the total cross-section is a function of α (identical with 1/K lambda/sub D/), T/sub e//T/sub i/, and anti Z as long as the temperature of all ion species is the same and T/sub e//T/sub i/ is not too large. Thus a measurement of the integrated ion cross-section at two different scattering angles can yield T/sub e//T/sub i/ and anti Z. This method is insensitive to magnetic fields and to moderate electron drifts. For 1 approximately less than T/sub e//T/sub i/, Z approximately less than 3 the cross-section must be measured to an accuracy of about 3% to give T/sub e/T/sub i/ to within 10% and anti Z within 20%.

26784 Bolometer for the investigation of a plasma. Kozlov, N.P.; Protasov, Yu.S. (Moscow Higher Technical School). *Instrum. Exp. Tech. (USSR) (Engl. Transl.);* **18**: No. 5, 1533-1534(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 5, 170-171(1975).

The construction of a low-inertia metallic bolometer with a bismuth thermistor, a time resolution 1.5 to 7 μsec, and a sensitivity 10^{-4} to 10^{-5} J/cm^2 is described which allows complete elimination of the internal photoeffect across the thermistor and avoidance of current contacts with the plasma. The presence of grids with retarding potentials allows separate recording of the energy contributions of charged particles, neutrals, and radiation in the absorption range of the receiving plate of the bolometer, as well as determination of the energy spectrum of the charged particles.

26785 Laser diagnostics in plasma research. Evans, D.E. (UKAEA Research Group, Abingdon. Culham Lab.). *Physica, B, C;* **82**: 27-42(Mar 1976).

From 12. international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The paper surveys some recent advances in plasma diagnostics by laser light scattering and is broadly divided according to whether the scattered radiation reflects uncorrelated electron motion or the motion of electrons and ions moving collectively. The first section deals with some attempts to solve technical problems such as stray light suppression and how to perform a continuous measurement of electron temperature Tsub(e). It also examines the interpretation of scattered light frequency distributions measured in hot plasmas. The second section is concerned with heterodyne detection and the development and application of long wavelength lasers to collective domain scattering in plasmas having very large Debye lengths, such as those found in thermonuclear fusion experiments.

26786 Determination of the parameters of a deuterium plasma in laser targets from neutron measurements. Kryuchenkov, V.B.; Lykov, V.A.; Shibarshov, L.I. *Sov. J. Quant. Electron. (Engl. Transl.);* **6**: No. 6, 730-731(Jun 1976).

A method is proposed for the determination of the density, electron temperature, and ion temperature of a deuterium plasma in laser targets from neutron measurements in the case when the T(d, n)He^4 reaction involves mainly fast tritons formed in the reaction D(d, p)T. (AIP)

26787 Microwave measurement of plasma density fluctuation amplitudes. Powers, E.J.; Simonen, T.C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *J. Appl. Phys.;* **47**: No. 9, 3911-3917(Sep 1976).

A microwave beam is used to detect ion-cyclotron oscillations in the 2XIIB mirror device. A model is used to estimate electron density and electric field oscillation amplitudes from measured modulation sideband intensities. Semiquantitative agreement is obtained with electrostatic probe measurements. (AIP)

26788 Coil probe method for determining the electron density and electron collision frequency in a magnetoplasma. Basu, J. (Saha Institute of Nuclear Physics, Calcutta, India). *J. Appl. Phys.;* **47**: No. 9, 4234-4236(Sep 1976).

A nonimmersive coil probe method is reported for determining the electron density and electron collision frequency in a low-pressure plasma column in the presence of a longitudinal mag-

netic field. It is shown how the parameters can be obtained by measuring the rf impedance of the coil probe placed coaxially around the plasma column. (AIP)

PLASMA KINETICS - GENERAL

26789 (BARC/I—366) **Progress report : Plasma Physics Section.** Iyyengar, S.K.; Rohatgi, V.K. (Bhabha Atomic Research Centre, Bombay (India)). Aug 1975. 91p. INIS.

The activities of the plasma physics section of the Bhabha Atomic Research Centre, India over the last five years (1970-75) are reported. The R and D programme of the section has been divided into four cells mainly i.e., (i) Thermal plasma (ii) Relativistic Electron Beam (iii) Energetics and (iv) Electron beam technology. The salient features of the development activities carried out in these cells are outlined. In the Thermal plasma group, considerable research work has been done in (a) fundamental plasma studies, (b) industrial plasma technology and (c) open cycle MHD power generation project. The relativistic electron beam group is engaged in improving the technology to realize high power lasers, and pulsed thermonuclear fusion. The energetics programme is oriented to develop high voltage d.c. generators and pulse generators. The electron beam techniques developed here are routinely used for melting refractory and reactive metals. The technical know-how of the welding machines developed has been transfered to industries. Equipment developed by this section, such as, (1) electron beam furnace, (2) plasma cutting torch, (3) impulse magnet charger etc. are listed.

26790 (INIS-mf—3042) **Wills Plasma Physics Department thirtieth 6-monthly progress report, 1st July—31st December 1975.** (Sydney Univ. (Australia). School of Physics). 1975. 7p. INIS.

Research is reported on the following topics: plasma sources, hydromagnetic shock waves, rotating plasmas, magnetohydrodynamics, laser diagnostics and far infrared interferometry.

26791 **Plasma focus devices.** Decker, G. (Stuttgart Univ. (TH) (F.R. Germany). Inst. fuer Plasmaforschung); Wienecke, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). *Physica, B, C;* **82**: 155-164(Mar 1976).

From 12. international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Plasma focus devices are presently investigated in about 20 laboratories. All these devices generated hot (some 100eV-some keV), dense (10^{17}-10^{20} particles cm^{-3}) and short-lived (5-200)ns) plasmas. Due to improved diagnostics and theoretical models considerable progress in the understanding of these devices has been made since their invention in the early 1960ies. The principle of operation, the important parameters for the mode of operation, the characteristic plasma properties and the possible applications (as realized or planned) are described.

26792 **Recent developments in low pressure gas discharge research.** Polman, J. (Philips Gloeilampenfabrieken N.V., Eindhoven (Netherlands). Natuurkundig Lab.). *Physica, B, C;* **82**: 125-140(Mar 1976).

From 12. international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

A review on recent developments in low pressure gas discharge research is given. After reference to a number of applications a discussion is given of some problems encountered including radiation transport theory, model calculations, and comparison of the results of these calculations with experimental data. Using a description of the current-modulated positive column and of model calculations, nonlinear ionization waves are elucidated. Other waves reviewed are those related to the thermal and acoustic instabilities causing arcing in molecular gas lasers, and diffusion waves. Some examples of diagnostic techniques, using thermo-couples, far infrared absorption, resonance fluorescence, and radioactive tracers are given. Finally the possibilities to use low pressure gas discharges as a tool in the study of collisional and radiative processes are discussed.

PLASMA KINETICS - EXPERIMENTAL

26793 (AD-A—010494) **Plasma acceleration in pulsed ablative arc discharges. Interim report, 15 Feb 1974—15 Mar 1975.** Palumbo, D.J.; Begun, M. (Fairchild Industries, Inc., Farmingdale, N.Y. (USA). Republic Div.). Mar 1975. Contract F44620-74-C-0055. 51p. (MS—147U001). NTIS $4.25.

The study was directed at obtaining a basic understanding of the physics of plasma acceleration in pulsed ablative arc discharges between parallel rail electrodes. The study consists of an experimental program, complemented by a realistic theoretical approach, for determination of the basic energy transfer and acceleration mechanisms in this type of plasma accelerator. The time dependent (continuum) equations of magnetohydrodynamics (MHD) with one spatial degree of freedom form the basis for theoretical analysis. These are coupled (via boundary and initial conditions) to the equations governing the flow of charge and energy from the capacitor bank to the plasma. A second order accurate explicit integration scheme is used to solve the equations. The plasma is assumed to have finite electrical conductivity but negligible viscosity and heat conductivity. (GRA)

26794 (JAERI-M—6096) **Effect of a radical electric field on the impurity transport.** Tuda, T. (Japan Atomic Energy Research Inst., Tokyo). Apr 1975. 11p. (In Japanese). INIS.

The problem of impurity transport in a Tokamak plasma is reconsidered, taking account of the radial electric field. Heavy impurity ions do not penetrate into the plasma column when the positive potential of the plasma exceeds a certain level.

PLASMA KINETICS - THEORETICAL

REFER ALSO TO CITATION(S) 26772, 26868

26795 (BUM—53) **On the evolution of a two component, two temperature, fully ionised plasma in electromagnetic fields.** Oeien, A.H. (Bergen Univ. (Norway). Dept. of Applied Mathematics; Bergen Univ. (Norway)). Jan 1975. 185p. INIS.

44 references. Thesis.

When inhomogenities and fields are not too strong, transients of distribution function, correlation functions and fields which may appear when the plasma evolves from an initial state out of equilibrium are derived, applying the multiple time scale method to the BBGKY and field equations. It is also shown that, at the end of an initial stage, kinetic equations and sets of approximate field equations will govern the evolution further on. In part II a study of the evolution further on is performed when conditions are such that distribution functions to lowest order may reach local Maxwellians with different temperatures for electrons and ions. Using the same method as above, the transient behaviour into a state where macroscopic and field equations take over the leadership in the evolution is derived, and the governing equations further on, together with correcting kinetic equations, are obtained up to an order of approximation higher than before. In part III a set of lower order and a set of higher order correcting kinetic equations from part II, which correspond partly to equations for the Chapman-Enskog and the Burnett levels of approximations, are solved qualitatively. New results for various transports of a two temperature plasma are obtained.

26796 (IPPJ—210) **Note on the motion of charged particles in an axi-symmetric crossed electro-magnetic field.** Horikoshi, G.; Hussain, A.; Kuroda, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1974. 12p. INIS.

Rotational frequency of a plasma cylinder immersed in a uniform magnetic field and an axisymmetric radial electric field which is proportional to radial distance from the axis is determined by a single particle model without collisions. The effects of the centrifugal and the Corioli's forces are taken into account which lead to final expressions of the rotational frequency and the effective magnetic field as seen by the particles in the rotating plasma cylinder with correction terms which are proportional to the radial electric field.

26797 (JAERI-M—6026) **Calculation code NIRVANA for free boundary MHD equilibrium.** Ninomiya, H.; Suzuki, Y.; Kameari, A. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 26p. (In Japanese). INIS.

The calculation method and code of solving the free boundary problem for MHD equilibrium has been developed. Usage of the code "NIRVANA" is described. The toroidal plasma current density determined as a function of the flux function PSI is substituted by a group of the ring currents, whereby the equation of MHD equilibrium is transformed into an integral equation. Either of the two iterative methods is chosen to solve the integral equation, depending on the assumptions made of the plasma surface points. Calculation of the magnetic field configurations is possible when the plasma surface coincides self-consistently with the magnetic flux including the separatrix points. The code is usable in calculation of the circular or non-circular shell-less Tokamak equilibrium.

26798 (JAERI-M—6143) **Numerical study of the time behaviour of impurity concentration in a Tokamak.** Amano, T.; Okamoto, M. (Japan Atomic Energy Research Inst., Tokyo). May 1975. 15p. INIS.

Numerical analysis has been made of the time evolution in density profiles of the impurities in a Tokamak. The diffusion and atomic processes of impurities are treated simultaneously. Two different numerical methods were used; the results are in good agree-

ment between the two. Calculations are made in the case of a constant spatial distribution of the plasma. The impurity concentration in the plasma is revealed. The procedure may be useful for analysis of the time evolution of a Tokamak plasma in computer simulation and for analysis of the impurities by spectrum measurement.

26799 (TRITA-EPP—75-23) **On the axially symmetric equilibrium of a magnetically confined plasma.** Lehnert, B. (Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). 22 Oct 1975. 19p. INIS.

The axially symmetric equilibrium of a magnetically confined plasma is reconsidered, with the special purpose of studying high-beta schemes with a purely poloidal magnetic field. A number of special solutions of the pressure and magnetic flux functions are shown to exist, the obtained results may form starting-points in a further analysis of physically relevant configurations.

26800 (UCID—17196) **FOKN: a relativistic Fokker-Planck code with large angle scattering and radiation losses.** Zimmerman, G.; Scharlemann, T.; Wood, L.; Weaver, T.; Chu, T.; Lee, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jul 1976. Contract W-7405-Eng-48. 37p. Dep. NTIS $4.00.

FOKN is a computer code which employs a relativistic Fokker-Planck algorithm to evolve the distribution functions of the various mutually interacting components of a multi-species plasma forward in time, with the optional addition of high angle, large energy and momentum transfer interactions between the various charged species of the plasma. As a computational expediency, the latter processes are handled by transfer matrices which are generated separately by another code, RNUX, so that once specific transfer matrices are generated, they can be used over and over by FOKN provided the group structures are compatible.

26801 **Plasma kinetic processes in a strong d.c. magnetic field.** Montgomery, D. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). *Physica*, *B*, *C*; **82**: 111-124(Mar 1976).

From 12. international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

Several recent results in the kinetic theory of a strongly magnetized plasma are surveyed. The emphasis is on the electrostatic guiding-center plasma in two dimensions, in both the fluid and 'charged rod' descriptions. The correspondence with inviscid hydrodynamics and the relevance of hydrodynamic turbulence theory are stressed. The basic kinetic description of the plasma is in terms of the statistically-distributed Fourier coefficients associated with the velocity and 'enstrophy' (charge density) fields. It is a universal tendency in such media for enstrophy to flow to shorter wavelengths but for energy to flow to longer wavelengths. This flow can be seen to be identical with thermalization in wave number space, and is not properly interpreted as having anything to do with normal modes or instabilities. A consequence of the energy flow to longer wavelengths is the generation of long-range order in the form of macroscopic vortices. These kinds of structure have historically been called 'convection cells' in plasma physics, and can be extraordinarily efficient at transporting particles transverse to a magnetic field. The tendency to vortex formation can be disrupted by collisions between particles. Therefore we have considered in some detail the modifications of the Fokker-Planck equation for a plasma produced by a strong d.c. magnetic field, in both two and three dimensions. (Auth.).

26802 **Recombination in an expanding laser-produced plasma.** Goforth, R.R.; Hammerling, P. (KMS Fusion, Inc., P.O. Box 1567, Ann Arbor, Michigan 48106). *J. Appl. Phys.*; **47**: No. 9, 3918-3922(Sep 1976).

A simple model of three-body recombination in a freely expanding plasma which is initially isothermal but whose initial density decreases with radius leads to a variation of ion charge state within the ion flow, in qualitative agreement with that observed in laser-produced plasma experiments. (AIP)

26803 **Magnetic fields due to impurity grains in laser-produced plasma.** Colombant, D.G.; Tidman, D.A.; Winsor, N.K. (Science Applications, Inc., McLean, Virginia 22101). *Appl. Phys. Lett.*; **29**: No. 7, 401-403(1 Oct 1976).

Results of a numerical simulation model are given for the magnetic field produced by an impurity grain embedded in a dense inhomogeneous plasma. (AIP)

26804 **Stimulated VUV emission from carbonlike ions in laser-produced plasmas.** Davis, J.; Whitney, K.G. (Plasma Physics Division, Naval Research Laboratory, Washington, D. C. 20375). *Appl. Phys. Lett.*; **29**: No. 7, 419-421(1 Oct 1976).

Population inversion for transitions in the VUV are predicted theoretically in laser-produced plasmas. The calculations are based on a time-dependent model that treats the excitation, ionization, and recombination dynamics of a dense argon plasma. Gains in excess of 10^3 cm/sup -1/ are obtained for the 3s-3p transition in carbonlike argon XIII for over 1000 psec. (AIP)

PLASMA PRODUCTION

26805 (BNWL—1939-3, pp 51-62) **Environmental effects of fusion concepts.** Apr 1976.

In Pacific Northwest Laboratory report on Controlled Thermonuclear Reactor Technology, January 1976—March 1976.

The CTR design concepts have been analyzed to determine the probable interactions with the environment and the resultant environmental effects. Although results based on current technology indicate that the CTR should have a lower total environmental impact than fission power plants, adverse impacts may result from an increase in construction material usage and increased employee radiation doses. Since commercial CTRs are not expected to operate for 40 to 50 years, future technical advances should lower these impacts. A draft document describing the analysis has been reviewed by the national fusion laboratories and appropriate ERDA administrators. Work is continuing on the model for the transport of tritium in the atmosphere over long periods of time. The computer code called FOOD has been revised to include a new specific activity approach for movement of tritium through food pathways.

26806 (IPPJ—213) **Production of a synthesized plasma.** Fukao, M.; Takeda, Y.; Yokota, M.; Okamoto, Y.; Kawai, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1975. 44p. INIS.

Neutralization of helium ion beam extracted from a stationarily operated duoplasmatron is studied. It was confirmed that the neutralization of ion space charge occurred mainly at the deceleration stage of the einzel lens, not in the downstream of the neutralizer. The magnetic field and arc current in the duoplasmatron affected substantially the beam divergence. The energy spectrum of the extracted ions was measured with an energy analyzing system consisting of a pre-decelerator and an electrostatic energy analyzer with 90° deflection. The energy spectrum of ions in the synthesized plasma was essentially defined by the operating conditions of the ion source; gas pressure, magnetic field and arc current in the arc discharge. A small difference between the space potential and the potential of the emitter changed the characteristics of the synthesized plasma.

26807 (UCRL—77730) **Collective behavior in recent laser-plasma experiments.** Kruer, W.L.; Haas, R.A.; Mead, W.C.; Phillion, D.W.; Rupert, V.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Jun 1976. Contract W-7405-Eng-48. 20p. (CONF-760635—2). Dep. NTIS $3.50.

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

The absorption of 1.06 μ light focused on small C_6H_6 discs has been measured in the intensity range of 10^{16} - 10^{17} W/cm. The data confirms the importance of collective plasma effects in determining the absorption of intense light. The measured absorption efficiencies are in the range of 30 to 40 percent, and the scattered light has a polarization dependence. The measured absorptions are shown to be inconsistent with classical inverse bremsstrahlung. Both the magnitude of the absorption and the observed polarization dependence of the scattered light are shown to be consistent with recent calculations of light absorption via collective processes. Comparisons are made, and improved models of the light absorption are discussed with reference to the data. In addition, the heated electron energies deduced from the x-ray data are consistent with those expected via collective processes.

26808 (UCRL—78235) **Laser-start-up system for magnetic mirror fusion.** Frank, A.M.; Thomas, S.R.; Denhoy, B.S.; Chargin, A.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 May 1976. Contract W-7405-Eng-48. 33p. (CONF-760513—9). Dep. NTIS $4.00.

From 22. international instrumentation of the Instrument Society of America; San Diego, California, United States of America (USA) (25 May 1976).

A CO_2 laser system has been developed at LLL to provide hot start-up plasmas for magnetic mirror fusion experiments. A frozen ammonia pellet is irradiated with a laser power density in excess of 10^{13} W/cm² in a 50-ns pulse. This system uses commercially available laser systems. Optical components were fabricated both by direct machining and standard techniques. The technologies used in this system are directly applicable to reactor scale systems.

26809 **Theory of anomalous energy flux and deposition in a laser produced plasma.** Manheimer, W.M.; Colombant, D.; Flynn, R. (Plasma Physics Branch, Plasma Physics Division, Naval Research Laboratory, Washington, D. C. 20375). *Phys. Fluids*; **19**: No. 9, 1354-1361(Sep 1976).

To study anomalous energy deposition and thermal flux in a collisionless plasma, the steady state fluid equations for the first four moments, density, velocity, temperature and heat flux are examined. The fluid system is coupled to the system of equations for the unstable waves, and the entire system is solved numerically for the case where the anomalous absorption mechanism is the Compton sidescatter instability. Absorption efficiency can be as high as twenty percent, albeit for very long plasma lengths. (AIP)

PLASMA INSTABILITIES

REFER ALSO TO CITATION(S) 26851, 26854

26810 (BUM—58) **Dynamic stabilization of the m=1 instability in a diffuse linear pinch.** Haaland, E.N.; Berge, G. (Bergen Univ. (Norway). Dept. of Applied Mathematics). Jul 1975. 28p. INIS.

10 references.

The effect of superimposing a time-oscillating, uniform z-field on a diffuse linear plasma pinch is investigated. The stability condition obtained for the m=1 mode shows that the diffuse pinch is less stable than the related sharp pinch. This indicates that the stability-analysis based on sharp pinch models might give too optimistic results. The theory is within the framework of ideal magnetohydrodynamics.

26811 (IPPJ—207) **Kink instability of a cylindrical tokamak with an arbitrary current distribution.** Itoh, K.; Yoshikawa, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1974. 16p. INIS.

A new method to analyze the MHD kink instability in the cylindrical approximation is presented. Using the nonlinear equilibrium equation with the helical perturbation method, an expression for the growth rate of instability of a perturbation is obtained. For m=1 mode, the growth rate and the stability-instability criterion, q(a)=1, are calculated analytically for an arbitrary current distribution. The growth rate is also calculated in the case of a uniform current.

26812 (IPPJ—211) **An effect of non-uniform electric field on drift-dissipative instability.** Terashima, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1974. 10p. INIS.

A dispersion relation of drift-dissipative mode in the presence of a non-uniform static electric field is derived from a kinetic model with the BGK collision operator. A finite gyroradius correction to the ion drift due to the electric field, which has a destabilizing effect, is thus reasonably introduced.

26813 (IPPJ—212) **Helical equilibria and criteria for the kink instability of cylindrical tokamak.** Inoue, S.; Itoh, K.; Yoshikawa, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1974. 14p. INIS.

Helical equilibria and criteria for the kink instability have been obtained numerically for various current distribution, including camel hump distribution. It is found that the unstable region expressed by q(a) is the largest in the case of uniform current.

26814 (JAERI-M—6167) **Impurity drift instability of dissipative type.** Tuda, T.; Tanaka, M. (Japan Atomic Energy Research Inst., Tokyo). Jun 1975. 6p. (In Japanese). INIS.

A new type of impurity drift instability is investigated in the short mean free path limit. This mode is driven by the ion parallel viscosity and is stabilized by the collisional diffusion of impurity ions across the magnetic field when the impurity concentration is lower than a certain value.

26815 (MATT—1242) **Nonlinear growth of the M = 1 tearing mode.** Waddell, B.V.; Rosenbluth, M.N.; Monticello, D.A.; White, R.B. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Apr 1976. Contract E(11-1)-3073. 16p. Dep. NTIS $3.50.

Numerical results are presented for the nonlinear evolution of the tearing mode with poloidal mode number one. Nonlinearly, the mode continues to grow exponentially at approximately the linear growth rate until it flattens the toroidal current inside the singular surface and increases the safety factor to unity at the plasma center. The hypothesis that the mode causes the internal disruption in tokamaks is supported by the fact that the time scale for the process agrees with experiment.

26816 (MATT—1246) **Numerical studies of the MHD spectrum of an elliptic plasma column.** Chance, M.S.; Greene, J.M.; Grimm, R.C.; Johnson, J.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). May 1976. Contract E(11-1)-3073. 62p. Dep. NTIS $4.50.

A numerical procedure is described for determining the MHD spectrum associated with small perturbations about an analytic equilibrium. This configuration has magnetic flux surfaces which are nested similar elliptical cylinders generated by a uniform axial current. Since the system is periodic, it models the essential features of a toroid. The code is used to study the properties of modes in the continuous shear Alfven and slow acoustic spectra as well as the discrete modes associated with the fast magnetosonic waves and kinks. Modes where the interchange criterion is violated, or nearly violated, are investigated.

26817 (MATT—1271) **Resistive internal kink modes.** Coppi, B.; Galvao, R.; Pellat, R.; Rosenbluth, M.; Rutherford, P. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jul 1976. Contract E(11-1)-3073. 12p. Dep. NTIS $3.50.

For realistic parameters of magnetically confined plasmas, the growth rates of internal kink modes, resulting from the effects of finite electrical resistivity, can be considerably larger than those evaluated from the idealized MHD theory. In addition magnetic field lines can reconnect and produce configurations with magnetic islands.

26818 **Review of glow discharge instabilities.** Allis, W.P. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). *Physica, B, C;* **82**: 43-51(Mar 1976).

From 12. international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

In a diffusion dominated discharge striations occur because excitations are reduced if the electrons can gain ionization energies in short distances and then ionize further on, but this process requires an energy transport distance Λ. This process no longer works in a recombination dominated discharge because any increase in electron density results in a decreased field and hence reduced ionization. However, if dissociative attachment is present the decreased field may result in decreased attachment and hence further increase the density, which is destabilizing. It seems that a negative differential conductivity dJ/dE, which must be stabilized externally by a series resistance, remains unstabilized internally between adjacent sections of the plasma. The negative thermal coefficient is always destabilizing and produces a transverse contraction unless it is neutralized by thermal conduction or electron diffusion. Recent work by Haas, Nigan and Wiegand and Douglas-Hamilton and Mani are reviewed.

26819 (TRITA-EPP—75-24) **Stabilization of localized modes in plasmas confined in poloidal magnetic fields.** Hellsten, T. (Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). Oct 1975. 18p. INIS.

The plasma contained in a 'spherator' system with a pure poloidal magnetic field and a surrounding gas blanket can be made absolutely stable against magnetohydrodynamic perturbations in the low-β limit. This situation can even be achieved for a sufficiently high ratio between the pressures in the thermonuclear region and the cold boundary region to satisfy reactor conditions, provided that the outer plasma boundary is chosen close to a separatrix.

26820 (TRITA-EPP—75-25) **On the stabilization of flute-type disturbances of a magnetized plasma.** Lehnert, B. (Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). 23 Nov 1975. 17p. INIS.

Flute-type disturbances are investigated by normal mode analysis in the case of low-beta plasma being confined in the field from a staight line current. A dispersion relation and stability criterion are derived including the joint effects of the plasma pressure, the finite ion Larmor radius and frequency, and of an imposed radial gravitation field. The results, which may also illustrate the general plasma behaviour in more complicated field geometries, indicate that the stability domain is enlarged substantially by finite Larmor radius effects, especially for small-scale disturbances. Also the centrifugal force in rotating plasma should have a stabilizing effect under certain conditions. In combination with the stabilizing mechanisms in the boundary regions of impermeable plasmas, the present results provide an alternative to the method of minimum-average-B stabilization.

26821 (UCRL—50002-75, pp 3-40) **Section 1. Confinement systems.** 15 Oct 1975.

In Controlled thermonuclear research. Annual report, July 1974—June 1975.

Major experimental and theoretical results achieved by the Controlled Thermonuclear Research (CTR) program at Lawrence Livermore Laboratory during FY 1975 gave the greatest encouragement to date that the ultimate goal of a deuterium-tritium-fueled mirror reactor can be reached. In the experimental program, the year was characterized by unusually important physics results from the 2XIIB experiment and by significant steps in the plan to change the Baseball II mode of operation. The stabilization of ion-cyclotron instabilities in the 2XIIB experiment by the introduction of an auxiliary warm plasma permitted the buildup of a high-temperature, high-density plasma with an n tau parameter an

order of magnitude larger than the 2XII experiment.I In the Baseball II experiment, preliminary tests and computer predictions indicated that a dense, transient, target plasma can be created by laser irradiation of a pellet in midflight through the center of the Baseball confinement zone.

26822 Nonlinear theory of the collisionless drift instability. Gross, L.S. Rochester, NY; Univ. of Rochester (1976). 117p. University Microfilms Order No.76-14,759.

Thesis (Ph. D.).

The nonlinear threshold behavior of the density driven collisionless drift instability is studied. This is accomplished by extending the work of Simon and Rosenbluth to the case of an inhomogeneous magnetized plasma. It is necessary to reformulate linear theory so as to incorporate finite geometry and clearly establish a neutral stable point. The analogues of the Case-Van Kampen normal modes must also be examined. A number of indeterminacies are resolved and then the nonlinear modifications of both the electron and ion distribution functions are obtained. From these one is able to calculate the limiting amplitude and frequency shift of the linearly unstable wave. A new small amplitude oscillating state is found. However, this state is itself unstable to small perturbations and hence cannot be experimentally observed. Instead the plasma moves "explosively" to a new state when the instability threshold is surpassed.

26823 Relativistic fluid equations with applications to the study of instabilities in magnetized beam—plasma systems. Ludwig, G.O. Ithaca, NY; Cornell Univ. (1976). 225p. University Microfilms Order No.76-15,897.

Thesis (Ph. D.).

The derivation and application of macroscopic equations which describe the behavior of multicomponent relativistic plasmas are discussed. Within this context, the important points here considered can be summarized as follows: (1) Derivation of the fully relativistic fluid equations for a Maxwellian plasma and for a strongly magnetized plasma. In particular, the equations of state for thermal equilibrium distributions are derived. (2) Canonical formulation of the relativistic fluid equations in Eulerian and Lagrangian coordinates. Derivation of the Hamiltonian density and of the energy integral. (3) Application of the fluid equations to the study of the two-stream instability in homogeneous plasmas, with the inclusion of relativistic and thermal effects. It is shown that for sufficiently high beam energies (γ/sub b/ greater than $\sqrt{2}$) the effect of the thermal spread of the beam becomes destabilizing, provided it is small enough to allow the hydrodynamic approximation. (4) Investigation of the stability of a beam of finite cross-section. Emphasis is given to a class of incompressible surface modes which are not completely stabilized by the external magnetic field. This instability results from the interaction between anti-parallel currents. The growth rate is reduced if the beam has a diffuse boundary.

26824 Lowering of the parametric-instability threshold by injection of an electron beam in a plasma. Gromov, S.N.; Pasechnik, L.L.; Semenyuk, V.F. (Nuclear Research Institute, Ukrainian Academy of Sciences). *JETP Lett. (USSR) (Engl. Transl.);* **23**: No. 3, 127-129(5 Feb 1976).

It is shown experimentally that injection into a plasma of an electron beam of low density makes it possible to lower appreciably the threshold of the parametric instability and to increase the energy drawn from the external high-frequency (RF) pump field. (AIP)

26825 High frequency parametric wave phenomena and plasma heating: a review. Porkolab, M. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). *Physica, B, C;* **82**: 86-110(Mar 1976).

From 12. international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

A survey of parametric instabilities in plasma, and associated particle heating, is presented. A brief summary of linear theory is given. The physical mechanism of decay instability, the purely growing mode (oscillating two-stream instability) and soliton and density cavity formation is presented. Effects of density gradients are discussed. Possible nonlinear saturation mechanisms are pointed out. Experimental evidence for the existence of parametric instabilities in both unmagnetized and magnetized plasmas is reviewed in some detail. Experimental observation of plasma heating associated with the presence of parametric instabilities is demonstrated by a number of examples. Possible application of these phenomena to heating of pellets by lasers and heating of magnetically confined fusion plasmas by high power microwave sources is discussed.

26826 Magnetic probe investigation of the disruptive instability in tokamak LT-3. Hutchinson, I.H. (Department of Engineering Physics, Research School of Physical Sciences, The Australian National University, Canberra, Australian Capital Territory, Australia). *Phys. Rev. Lett.;* **37**: No. 6, 338-341(9 Aug 1976).

A multicoil, internal magnetic probe is used to follow the development of the plasma current profile through the disruptive instability. The initial perturbation of the current channel is localized between the singular surfaces q=1,2 present within the plasma. Subsequently, during the main disruption, peak toroidal electric fields approximately-greater-than10 times the quiescent value are observed near axis. It is suggested that microturbulence is responsible for this extreme resistivity anomaly. (AIP)

26827 Measurements of ion cyclotron instability characteristics in a mirror-confined plasma. Simonen, T.C. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). *Phys. Fluids;* **19**: No. 9, 1365-1370(Sep 1976).

Frequency spectrum, wavelength, and phase velocity measurements of ion cyclotron oscillations in a mirror-confined plasma are described. The measured potential amplitudes reach, but do not exceed, the electron temperature. Other experiments in this device, not discussed here, reveal a wide range of plasma conditions where these oscillations are not detected. (AIP)

26828 Nonlinear tokamak stability. Strauss, H.R. (Fusion Research Center, University of Texas at Austin, Austin, Texas 78712). *Phys. Fluids;* **19**: No. 9, 1411-1416(Sep 1976).

The nonlinear energy theorem of Rosenbluth for helically symmetric tokamak magnetohydrodynamic motions is used to find nonlinear corrections to the linear stability of kink modes. Near marginal stability these corrections are important and give a finite amplitude threshold for instability. Cases are also found in which a mode saturates at low amplitude, in agreement with previous calculations. (AIP)

26829 Evolution of nonlinear magnetohydrodynamic mode structures. Jones, R. (General Atomic Company, San Diego, California 92138). *Phys. Fluids;* **19**: No. 9, 1425-1426(Sep 1976).

A pinch plasma column in a conducting chamber (a ≅0.6) first developes the m=0 concave "sausage" instability predicted by elementary theory. The shoulder of the solitary wave thickens (a ≅0.75), destabilizing a convex sideband constituting transition from solitary wave to periodic mode structure. (AIP)

PLASMA WAVE PHENOMENA

26830 (INIS-mf—3000) **Certain relativistic effects due to strong electromagnetic fields in plasmas.** Tsintsadze, N.L. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1974. 5p. INIS.

It is shown that the propagation of a strong electromagnetic wave in an electron plasma can lead to a generation of a constant electron current along the direction of propagation and to a large increase in the average electron density.

26831 (INIS-mf—3001) **On the dynamics of sonic-Langmuir solitons.** Karpman, V.I. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1974. 11p. INIS.

The nonstationary evolution of nonlinear Langmuir waves is considered. In particular the process of soliton formation is studied in the case where the perturbation propagates with a speed close to that of sound. The influence of electron collisions on the motion of the soliton is also described.

26832 (INIS-mf—3002) **Anomalous reflection of laser radiation due to the build-up of ion-sound waves in a plasma.** Gustavsson, H.G. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1974. 49p. INIS.

A numerical approach is used to study the temporal development of the excitation levels of ion-sound waves and the associated reflection and transmission properties, when laser radiation falls onto a plasma. The problem is treated in one dimension and the random phase approximation is used.

26833 (INIS-mf—3003) **Nonresonant wave-coupling and wave-particle interactions.** Anderson, D. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1975. 17p. INIS.

The interaction between two primary waves and their corresponding nonresonant beatwave is studied. The beatwave is assumed to interact strongly with the plasma particles, thus causing a heating of the plasma and an energy transfer between the primary waves. The process can be interpreted as direct nonlinear interaction between the primary waves and the particles. The results of the general analysis are applied to the phenomenon of beat heating of a plasma by means of two laser beams, and also to the stimulated Compton scattering effect.

26834 (INIS-mf—3004) **Effect of stochastic mismatch on parametric excitation.** Anderson, D.; Bondeson, A. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1975. 22p. INIS.

The effect of random inhomogeneities upon the power and amplitude growth rates of two parametrically coupled modes is studied. An equation is derived, which determines the statistical properties of the local growth rate γ(x), and the global growth rate γsub(eff) is calculated by averaging quantities of the form exp(∫(0yieldsx)γγ¼'z'₁)dx₁).

26835 (IPPJ—206) **Two-dimensional stability of ion-acoustic solitons.** Kako, M.; Rowlands, G. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1974. 13p. INIS.

Nonlinear ion-acoustic waves are analyzed in two-dimensional space. Korteweg-de Vries equation modified with a subsidiary equation is derived, from which it is shown that solitons are stable against disturbances at a right angle to their propagation direction.

26836 (IPPJ—214) **Modified Clemmow-Mullaly-Allis diagram for large-amplitude electromagnetic waves in magnetoplasmas.** Minami, K.; Mori, Y.; Takeda, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1975. 19p. INIS.

A possible modification to the well known Clemmow- Mullaly-Allis diagram is analysed taking into account the radiation pressure force due to a large-amplitude electromagnetic field E in magnetoplasmas. We restrict ourselves here to the propagations parallel (the right and left-hand circularly polarized waves) and/or perpendicular (the ordinary and extraordinary modes) to the static magnetic field Bsub(o). We analyse electromagnetic waves incident normally on a semi-infinite uniform plasma, on which Bsub(o) is applied parallel and/or perpendicular to the surface. Considerations are limited to a cold collisionless plasma where the incident waves are evanescent. Simple expressions are obtained for the cut-off conditions of the waves except the extraordinary mode. In the latter case, the cut-off condition is calculated numerically solving an integral equation. The results are demonstrated in the usual Clemmow-Mullaly-Allis diagram for the various values of b=2Esub(i)² c²/m ω²kappaTsub(e ') where Esub(i) and ω are, respectively, the amplitude and the angular frequency of the incident wave. The cut-off lines are shown to move towards the higher densities with increasing b.

26837 (LBL—3315) **Upper-hybrid solitons.** Kaufman, A.N.; Stenflo, L. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1974. 5p. INIS.

A nonlinear upper hybrid wave with negative dispersion propagates across a magnetic field as a soliton, when its pulse speed exceeds the magnetosonic speed.

26838 (LBL—5200) **Diffusion due to a single wave in a magnetized plasma.** Smith, G.R.; Kaufman, A.N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 10 May 1976. Contract W-7405-ENG-48. 11p. (CONF-760635—3). Dep. NTIS $3.50.

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

Hamiltonian methods are used to study the motion of a particle in the field BZ and a single electrostatic wave. The particle motion is studied by numerically integrating the equations of motion. Diagrams of various particle trajectories are given. (MOW)

26839 (LBL—5201) **Generalized ponderomotive forces and three-wave interaction.** Johnston, S.; Kaufman, A.N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 29 Apr 1976. Contract W-7405-ENG-36. 8p. (CONF-760635—1). Dep. NTIS $3.50.

From Nobel symposium on nonlinear effects in plasmas; Lerum, Sweden (11 Jun 1976).

A unified Hamiltonian approach to the theory of nonlinear interactions among waves and particles is discussed. The unifying feature of the approach is a generalization of the concept of pondermotive force. The usual method of time averaging is replaced by a canonical transformation. The transformation is designed to eliminate the terms in the Hamiltonian of a particle which are linear in the wave potentials, replacing them with bilinear terms at combination frequencies. An oscillation center approach is illustrated by deriving a compact general formula for the three-wave coupling coefficient in collisionless plasma. (MOW)

26840 **Mode coupling of electron plasma waves.** Harte, J.A. Davis, CA; Univ. of California (1975). 120p. University Microfilms Order No.76-14,211.

Thesis (Ph. D.).

The driven coupled mode equations are derived for a two fluid, unequal temperature (T/sub e/ much greater than T/sub i/) plasma in the one-dimensional, electrostatic model and applied to the coupling of electron plasma waves. It is assumed that the electron to ion mass ratio identical with /sup m/e/M/sub i/ much less than 1 and eta²/sub ko/ k lambda/sub De/ less than 1 where eta²/sub ko/ is the pump wave's power normalized to the plasma thermal energy, k the mode wave number and lambda/sub De/ the electron Debye length. Terms up to quadratic in pump power are retained. These equations describe the linear plasma modes oscillating at the wave number k and at ω/sub ek/, the Bohn Gross frequency, and at Ω/sub k/, the ion acoustic frequency, subject to the damping rates ν/sub ek/ and ν/sub ik/ for electrons and ions and their interactions due to intense high frequency waves E/sub k//sup l/. The background density is n/sub o/, n/sub ik/ the fluctuating ion density, and ω/sub pe/ the plasma frequency.

26841 **Theoretical studies of some nonlinear laser-plasma interactions.** Cohen, B.I. Berkeley, CA; Univ. of California (1975). 213p. University Microfilms Order No.76-15,144.

Thesis (Ph. D.).

The nonlinear coupling of intense, monochromatic, electromagnetic radiation with plasma is considered in a number of special cases. The first part of the thesis serves as an introduction to three-wave interactions. A general formulation of the stimulated scattering of transverse waves by longitudinal modes in a warm, unmagnetized, uniform plasma is constructed. A general dispersion relation is presented that describes Raman and Brillouin scattering, modulation instability, and induced Thomson scattering. Raman scattering (the scattering of a photon into another photon and an electron plasma wave) is investigated as a possible plasma heating scheme. The stimulated scattering of a coherent electromagnetic wave by low frequency density perturbations in homogeneous plasma is considered. A composite picture of the linear dispersion relations for filamentation and Brillouin scattering is constructed. The absolute instability of Brillouin weak and strong coupling is studied by analytic and numerical means.

26842 **Observations of radio frequency generated waves in a barium Q-plasma near the lower hybrid resonance.** Coble, L.E. Austin, TX; Univ. of Texas (1975). 162p. University Microfilms Order No.76-14,426.

Thesis (Ph. D.).

A Q-machine and associated equipment including diagnostic equipment was designed and constructed such that radio frequency waves having frequencies near the lower hybrid resonance could be inductively and electrostatically coupled into the barium Q-plasma where the characteristics of these waves could be monitored in the radial direction in the plasma. The inductive coupled wave was launched from a single turn loop and the electrostatic coupled wave from split cylinder capacitor plates. Nonlinear interactions of an inductive coupled wave and an electrostatic coupled wave were observed. With the frequencies of the two waves and the plasma density being such that both waves propagated completely through the plasma, it was found that the nonlinear term was of the form of the product of the amplitude of the electrostatic coupled wave and the radial derivative of the amplitude of the inductive coupled wave. It was also only mentioned that the parametric stabilization and destabilization of drift waves by the lower hybrid fields may have been observed.

26843 (ERDA-tr—149) **"Drift" oscillation of Alfven waves by blocked electrons in a tokamak when β/sub ∥/ greater than or equal to 1.** Mikhaylovskii, A.B. Translated from *Fiz. Plazmy;* 1: No. 3, 378-392(1975). 19p. Dep. NTIS $3.50.

The initial equations for Alfven waves are described. The drift kinetic equation for particles in the field of an Alfven wave is converted to a form sikilar to a kinetic equation which makes it possible to use a simple procedure for calculating the incremental increase in the oscillations. The dispersion equation describing the Alfven waves interaction with blocked electrons is derived. The Alfven waves incremental increase is calculated. (MOW)

26844 **Excitation of surface waves in ion-beam plasma and compression of a neutralized ion beam.** Gabovich, M.D.; Levitskij, S.M.; Soloshenko, I.A. (AN Ukrainskoj SSR, Kiev. Inst. Fiziki). *Zh. Eksp. Teor. Fiz., Pis'ma. Red.;* 1: No. 9, 416-419(12 May 1975). (In Russian).

Letter-to-the-editor.

26845 **Electromagnetic wave-wave interactions in a bounded magnetoplasma.** Kent, G.; Thomas, D.; Kent, P. (Syracuse Univ., N.Y. (USA)). *Int. J. Electron.;* 40: No. 2, 105-122(Feb 1976).

The equations, valid in the weak non-linear approximation, are derived to describe the interaction of two waves of different frequency in a bounded, uniform, cold, collisional magnetoplasma.

The boundaries are the walls of a cyclindrical cavity resonator, the magnetization is axial, and ion motion is neglected. A matrix formalism is used to obtain a general solution satisfying boundary condition for a Fourier component in time, azimuthal, and axial coordinates. The solution is applied to the excitation of the TM-011 mode by the harmonic of the TM-010, when both are resonant. The computed results show a decrease of harmonic amplitude at the cavity wall as the magnetization is increased from zero and an abrupt increase of several orders of magnitude when the harmonic is close to the upper hybrid resonance. An equivalent circuit is proposed to account for the results at low magnetization, but it fails for cyclotron frequencies greater than the fundamental frequency. For all magnetic fields, the harmonic amplitude is inversely proportional to the collision frequency. A second application is to the excitation of a resonant Trivelpiece mode by the interaction of two resonant high frequency modes. In this case infinite magnetization is assumed. The results show Trivelpiece mode excitation to be less than the harmonic generation by at least one order of magnitude. Since calculations apply to one set of cavity dimensions, the requirement of simultaneous resonance at two or more frequencies limits the variation of plasma frequency. No conclusions concerning the effects of this parameter can be drawn.

26846 Diffraction by a half-plane immersed in a moving anisotropic plasma. Tan, H.S. (Malaya Univ., Kuala Lumpur (Malaysia)). *Int. J. Electron.;* **40**: No. 2, 137-146(Feb 1976).

The boundary value problem of plane-wave diffraction by a conducting half-plane immersed in a moving anisotropic plasma is solved, using the method of diffraction functions. The E-polarization case yields solutions similar to that of a half-plane in a stationary medium and does not give any new features. The H-polarization problem is solved with the assumption that the plasma motion is non-relativistic. The solution shows that under these circumstances the half-plane scatters as if its surfaces have an equivalent surface reactance. The solution then contains a surface wave propagating along both the half-plane surfaces.

26847 Stationary states for electron oscillators in a rare-gas afterglow plasma. Dutt, T.L. (Polytechnic of North London (UK)). *J. Phys., B (London);* **9**: No. 3, 547-562(21 Feb 1976).

An explanation is advanced for the presence of populations of low energy oscillating paired electrons in rare-gas afterglow plasmas arranged in a system of coaxial shells, and enclosing a core plasma of free electrons. The common axis of the system is that of the long glass tube containing the plasma. The explanation is based on Fermi's analysis of the collisional interaction of very low energy electrons with gas atoms or molecules. A model afterglow is evolved based on the coaxial shell hypothesis, and is used to interpret two sets of afterglow phenomena, namely the plasma shell resonances obtained when energy is radiated by electrons making transitions from inner to outer shells, and the multiple values for accelerated decay times observed for afterglows of this type.

26848 Wave-wave interaction in plasmas. Wilhelmsson, H. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Elektromagnetisk Faeltteori). *Physica, B, C;* **82**: 52-60(Mar 1976).

From 12. international conference on phenomena in ionized gases; Eindhoven, The Netherlands (18 Aug 1975).

The paper elucidates the general topic of wave-wave interaction in plasmas by discussing some basic questions entering the analysis of nonlinear interactions of waves. It considers coherent nonlinear wave-wave interaction for nonlinearly stable as well as (explosively) unstable situations. Effects of saturation (due to nonlinear phase shifts) and dissipation (with mutually different linear damping of waves) are included. Particular attention is paid to the dynamics of the phases of the waves. For the problem of external excitation of the nonlinear effects, e.g. the stimulated Brillouin and Raman scattering processes occurring in laser-plasma interaction, the influence of deviation from perfect coherency of the pump wave (the incident laser beam) is considered, including the effects of pump depletion during the nonlinear coupling process. The results of a numerical analysis of the problem of transition between a coherent wave state of interacting waves and a random phase situation are also described. Finally, the nonlinear excitation of a nonresonant beat-wave, which interacts strongly with the plasma particles is discussed. Such a process is of considerable interest in connection with the heating of a plasma. It can also be viewed as a mechanism responsible for the stimulated scattering of waves by electrons, i.e., for the stimulated Compton scattering, and for beat-wave heating of plasmas. In fact, the problem of the Landau-damped nonresonant beat-wave may be viewed as a link between the descriptions of wave-wave and wave-particle interactions.

26849 Reflection and transmission of electromagnetic waves by a semi-infinite uniaxial plasma moving perpendicular to the plane of incidence. Ohkubo, M. (Gumma Univ., Kiryu, Japan). *Radio Sci.;* **11**: No. 7, 573-582(Jul 1976).

The reflection and transmission properties of electromagnetic waves by a semi-infinite uniaxial plasma moving perpendicular to the plane of incidence are investigated theoretically for the incident H and E plane wave. In this case, the plasma becomes anisotropic, and electromagnetic field components of the transmitted wave should be hybrid modes. Thus it is shown that the behavior of the power reflection coefficient is remarkably different from that of a stationary one.

26850 Frequency shifts of large-amplitude plasma waves. Kim, H. (Institute for Plasma Research, Stanford University, Stanford, California 94305). *Phys. Fluids;* **19**: No. 9, 1362-1364(Sep 1976).

The time-asymptotic value of the frequency of a large-amplitude, electrostatic, electron plasma wave is studied over a wide range of amplitudes and phase velocities. When the amplitude is relatively small, the asymptotic frequency is less than the linear value, and the frequency shift increases with the square root of the amplitude. At larger amplitudes, the frequency shift increases more slowly, reaches a maximum, and then decreases. The asymptotic frequency finally becomes greater than the linear value. (AIP)

26851 Excitation of ion cyclotron harmonic waves with an ion beam of high perpendicular energy. Bohmer, H. (Physics Department, University of California, Irvine, California 92717). *Phys. Fluids;* **19**: No. 9, 1371-1374(Sep 1976).

The interaction of a rotating ion beam with a plasma in an external magnetic field is investigated. The ion beams have an energy component perpendicular to the magnetic field which is large compared with the energy of the background plasma ions. It is shown that the interacton leads to the excitation of ion cyclotron harmonic waves with a growth rate which can be as large as ω/sub c//sub i//2. It is also shown, using a theoretical argument, that the growth rate for the excitation of ion cyclotron waves by a purely longitudinal beam is comparatively small. (AIP)

26852 Anharmonic oscillator description of plasma oscillations. Mahaffey, R.A. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Phys. Fluids;* **19**: No. 9, 1387-1391(Sep 1976).

Three recently investigated plasma oscillations have been found to be described by a nonlinear differential equation of the form $d^2x/dt^2+\omega_0^2x+bx^2+ax^3=0$. This equation is similar to the Duffing equation, but has many additional features. These features include additional shifts in the frequency of oscillation, asymmetry of the amplitude of oscillation, effects on the phase plane singularities, and changes in the resonance response curve. A discussion of each of these features is presented and a comparison of these features with experiment is made. (AIP)

26853 Excitation of fast waves by slow waves near the lower-hybrid frequency. Berger, R.L.; Chen, L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). *Phys. Fluids;* **19**: No. 9, 1392-1394(Sep 1976).

Resonant and nonresonant decay of short wavelength lower-hybrid waves into long wavelength whistler waves and ion acoustic waves are considered. It is shown that the dominant coupling to the ion acoustic mode arises from the magnetic force producing a pressure along the magnetic field lines. This decay instability provides a mechanism for dissipating the wave energy that is observed to accumulate in the lowest frequency lower-hybrid waves. (AIP)

26854 Comments on "Trapped particle instability". Jahns, G.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Fluids;* **19**: No. 9, 1432(Sep 1976).

It is noted that a recent theoretical paper on the instability growth rate of electron plasma waves is in agreement with experiment. (AIP) (AIP)

THERMONUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 25728, 25923, 25924, 25927

26855 (BNWL—1939-3) **Pacific Northwest Laboratory report on Controlled Thermonuclear Reactor Technology, January 1976—March 1976.** (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1976. Contract E(45-1)-1830. 70p. Dep. NTIS $4.50.

Separate abstracts were prepared for the three included sections. (MOW)

26856 (GA-A—13883) **Construction of Doublet III, a major step toward fusion power.** Gilleland, J.R.; Ohkawa, T. (General Atomic Co., San Diego, Calif. (USA)). 1976. Contract E(04-3)-167. 7p. (CONF-760469—2). Dep. NTIS $3.50.

From American power conference; Chicago, Illinois, United States of America (USA) (20 Apr 1976).

A review of the Doublet I, II, and III facilities is given. Some machine parameters of Doublet III are toroidal field 26 kG, major radius 1.43 m, central plasma density 2 x 10^{14} cm^{-3}, and ion temperatures of 10^{8} °K. The experimental power reactor being planned after the experimental testing of Doublet III has been completed is briefly described. (MOW)

26857 (GA-A—13896) **General Atomic noncircular tokamak demonstration power reactor: blanket/shield, tritium and power conversion ststems.** (General Atomic Co., San Diego, Calif. (USA)). 19 Mar 1976. Contract E(04-3)-167. 60p. (CONF-760343—2). Dep. NTIS $4.50.

From Blanket/power systems for fusion reactors) technology workshop; Upton, New York, United States of America (USA) (29 Mar 1976).

A reference conceptual design for a noncircular tokamak power reactor has been established and developed in a preliminary form. Since an important objective of the design is that it incorporates technological scaling from experimental power reactor(s), the reference plant has retained certain major design features in common with the noncircular EPR reference conceptual design. The major design parameters of the reactor are given. The reactor has a 7 m major radius and a net electrical output just over 500 MW(e). A primary engineering objective in the design is the minimization of expensive and time-consuming remote maintenance operations by designing the reactor to permit hands-on maintenance externally to the shield system and toroidal-field coils. To this end the outboard shield is comprised of low activity materials and flux levels at the toroidal field coils are intentionally reduced to levels well under those based on coil refrigeration and annealing criteria. A conventional steam power conversion cycle is briefly described.

26858 (JAERI-M—6102) **The first results on JFT-2a.** Shimomura, Y.; Nagashima, T.; Kitsunezaki, A.; Maeda, H.; Ohtsuka, H. (Japan Atomic Energy Research Inst., Tokyo). Apr 1975. 49p. INIS.

JFT-2a (DIVA) is a Tokamak device with teardrop-like cross section capable of operating with an axisymmetric divertor. The research objectives of the device are to study plasma confined in teardrop-like magnetic surface configurations with and without a separatrix magnetic surface, and to investigate the characteristics of an axisymmetric magnetic limiter and/or divertor. Preliminary measurements indicate that a positionally-stable plasma enclosed in a separatrix magnetic surface is produced. The plasma extending towards the divertor hoop near the separatrix magnetic surface has a density an order of magnitude lower than that of confined plasma. In the gross behavior of the plasma, there are no significant differences whether or not the plasma is enclosed in a separatrix magnetic surface and no adverse effects of the separatrix magnetic surface on the plasma confinement are observed.

26859 **Neutralised collliding beam torus.** Kulsrud, R.M.; Jassby, D.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). *Nature (London)*; **259**: No. 5544, 541-544(19 Feb 1976).

A new type of deuterium-tritium fusion reactor is described, consisting of two dense oppositely-directed D and T plasma components confined in a torus. These components can be formed by neutral-beam injection at moderate energies. The reactor could have significant power gain with relatively lenient plasma confinement requirements.

26860 (ERDA-tr—112) **Review of the present status of work on tokamaks in the USSR.** Mirnov, S.V.; Mukhovatov, V.S.; Strelkov, V.S.; Shafranov, V.D. Jun 1976. Translation of Russian report. 27p. Dep. NTIS $4.00.

The main task of investigations in the Tokamak program is in study of methods of improving the thermonuclear parameters of plasma. In the Soviet Union this program is oriented toward approximately 15 different installations which may be divided into five groups according to their purposes. (1) The direct method of increasing plasma parameters by increasing the parameters of installations. The chain of T-4, T-10, and T-20 tokamaks serves for this purpose. (2) The search for new configurations which permit reduction of expenditures to create a thermonuclear plasma. The small T-8 and T-9 tokamaks with non-circular plasma column cross-section serve this purpose. (3) Restriction of entry of impurities—it is proposed that this problem be solved on T-12, TO-2, TM-4, and TB-0 installations. (4) Additional heating and stabilization are being studied on the TM-3, Tuman-2, T-11, TF-1, TM-1-VCh, and TO-1 installations. (5) New principles of creating magnetic systems—the T-7. Seven of the 17 installations enumerated above are now operating: the T-4, TM-3, T-9, Tuman-2, TO-1, TF-1, and TM-1-VCh. The T-10, T-8, and T-11 installations are now being readied to conduct experiments. The T-12, TO-2, TM-4, T-7 and Tuman-3 installations are in the stage of manufacture. The TB-0 and T-20 installations are being designed.

26861 **Profiles and polarizations of the Balmer-α line from high-temperature hydrogen atoms in strong magnetic fields.** Isler, R.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Phys. Rev., A;* **14**: No. 3, 1015-1019(Sep 1976).

Energies and eigenstates are obtained for the n = 2 and n = 3 levels of hydrogen atoms moving in strong magnetic fields. The Hamiltonian of the system includes the interaction with the Lorentz field, E = v x B, as well as the magnetic interaction, -mu-arrow-right x B. These results are utilized together with the Doppler shifts in order to obtain profiles and polarizations of the Balmer-α line in tokamak-like environments under the assumption that the velocity distributions are Maxwellian. (AIP)

PHYSICS AND BLANKET ENGINEERING

26862 (BNL—20725) **Analysis of steady state graphite blankets.** Fillo, J.A.; Powell, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 24p. (CONF-760621—2). Dep. NTIS $4.00.

From 25. Heat Transfer and Fluid Mechanics Institute Meeting; Davis, California, United States of America (USA) (21 Jun 1976).

A computer code was developed for two-dimensional, nonsteady heat conduction in heterogeneous, anisotropic solids with non-uniform volumetric internal heating. Fixed boundary temperatures, thermal radiation and arbitrary heat flux boundary conditions are accommodated. Coolant tubes are taken into account by prescribing fluid temperatures and heat transfer coefficients. With regard to coolant tubes, we allow for: (a) heat capacitance in the tube wall, coolant tube in contact with the structural material; (b) zero heat capacitance in the tube wall, coolant tube in contact with the structural material; and (c) zero heat capacitance in the tube wall, radiation gap between the wall and structure. The finite difference equations are solved by the standard explicit method. The following topics are developed: (a) the finite difference equations for internal nodes; (b) detailed development of thermal radiant flux expressions with view-factor determination; (c) thermal radiation boundary conditions coupled with conduction equation; and (d) solution method.

26863 (BNL—21158) **Review: BNL graphite blanket design concepts.** Fillo, J.A.; Powell, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). Mar 1976. 210p. (CONF-760343—1). Dep. NTIS $7.75.

From Blanket/power systems for fusion reactors) technology workshop; Upton, New York, United States of America (USA) (29 Mar 1976).

A review of the Brookhaven National Laboratory (BNL) minimum activity graphite blanket designs is made. Three designs are identified and discussed in the context of an experimental power reactor (EPR) and commercial power reactor. Basically, the three designs employ a thick graphite screen (typically 30 cm or greater, depending on type as well as application-experimental power reactor or commercial reactor). Bremsstrahlung energy is deposited on the graphite surface and re-radiated away as thermal radiation. Fast neutrons are slowed down in the graphite, depositing most of their energy. This energy is then either radiated to a secondary blanket with coolant tubes, as in types A and B, or is removed by intermittent direct gas cooling (type C). In types A and B, radiation damage to the structural material of the coolant tubes in the secondary blanket is reduced by one or two orders of magnitude by the graphite screen, while in type C, the blanket is only cooled when the reactor is shut down, so that coolant cannot quench the plasma, whatever the degree of radiation damage.

26864 (BNWL—1939-3, pp 3-15) **Fusion systems engineering.** Apr 1976.

In Pacific Northwest Laboratory report on Controlled Thermonuclear Reactor Technology, January 1976—March 1976.

In fusion systems engineering a coordinated effort between scientists and engineers from PPPL and PNL is underway to evaluate the Two Component Torus concept and develop a conceptual design for a fusion-fission hybrid. An information requirements document is being prepared. The design, operation, and economic information that should be included in documents describing CTR design concepts is outlined to assure satisfactory economic and environmental comparisons of CTR designs. The first three fusion-fission hybrid evaluation cases of the ten proposed in the last quarterly report have been completed. The three cases are: (1) LMFBR introduced in 1992, no CTR, (2) CTR introduced in

2010, no LMFBR, and (3) neither LMFBR nor CTR. The results indicate that there is a role for the hybrid even with successful development of the pure CTR.

26865 (JAERI-M—6072) **Neutronic calculation on fussion reactor blanket by Ssub(n) approximation.** Moriyama, M.; Seki, Y.; Maekawa, H. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 28p. (In Japanese). INIS.

Validity of the Ssub(n) approximation which is used for neutronics calculation of the fusion reactor blankets is confirmed by comparing the calculated tritium breeding ratio in the benchmark model with the recommended one. Effects of the following on accuracy of the calculated tritium breeding ratio were studied: The number of energy groups, the number of directional mesh points in the Ssub(n) approximation, anisotropy of neutron scattering, and selection of the spatial mesh number.

26866 (UCRL—77887) **Potential for fissile breeding with the fusion-fission hybrid reactor.** Bender, D.J.; Lee, J.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Jun 1976. Contract W-7405-Eng-48. 35p. (CONF-760622—30). Dep. NTIS $4.00.

From American Nuclear Society 1976 annual meeting; Toronto, Ontario, Canada (13 Jun 1976).

The general features of the mirror reactor design are discussed. Details of the blanket-coil geometry are shown. The inside face of the blanket segments are divided into individual pressure vessels. These submodules contain fissile breeding material located directly behind the first wall, a fusile breeding material behind the fertile breeder, and then coolant inlet and outlet plena. Two blankets are examined and compared in this study. One contains natural uranium plus 7 wt. percent Mo, the second contains thorium metal. The performance of these blankets is discussed. (MOW)

MAGNET COILS AND FIELDS

26867 (JAERI-M—5999) **Effect of eddy currents in the toroidal field coils of a tokamak with an air-core transformer.** Tani, K.; Kobayashi, T.; Tamura, S. (Japan Atomic Energy Research Inst., Tokyo). Feb 1975. 28p. (In Japanese). INIS.

The effect of eddy currents in the copper parts of the toroidal field coils is evaluated for a tokamak with the air-core transformer windings located inside the bore of the toroidal field coils. By introducing appropriate weights to the solutions obtained for a simplified cylindrical model, calculation is made of the induction toroidal electric field on the plasma axis in the presence of the eddy currents. The result shows that, to reduce the influence of the eddy currents on the induction one-turn voltage to the permissible level, it is necessary to choose the optimal number of turns and shape of the single conductor of the toroidal field coil.

26868 (JAERI-M—6025) **Poloidal magnetic configurations and plasma equilibrium.** Ninomiya, H.; Suzuki, Y.; Kameari, A. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 17p. (In Japanese). INIS.

A calculation method of solving the free boundary problem for MHD equilibrium has been developed for a large Tokamak with large confinement time in the next phase of fusion research. The method is applied to study the relations between plasma characteristics, geometrical position and shape, and the poloidal fields. The poloidal coil system consists of the vertical, magnetic-limiter and quadrupole-field coils. Calculation of the magnetic field configuration is possible when the plasma surface coincides self-consistently with the magnetic flux including the separatrix points. It is also applicable to calculation of the circular or non-circular shell-less Tokamak equilibrium.

26869 (JAERI-M—6027) **Determination of magnetic configuration for MHD equilibrium in a large Tokamak device.** Kameari, A.; Suzuki, Y.; Ninomiya, H. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 16p. (In Japanese). INIS.

A numerical method for determining the magnetic configuration for MHD equilibrium has been developed, which is used in design of JT-60, a large Tokamak device. The alternating direction implicit method coupled with the 3-step iteration scheme is further improved by addition of the appointment process of plasma parameter (plasma position, shape and current). Operational regime of the vertical field and quadrupole field in JT-60 is determined by this method, and also position and necessary current intensity of the magnetic limiter coils. The calculation is compared with the analytical.

26870 (JAERI-M—6028) **MHD equilibrium code for design of poloidal magnetic configuration 'EQUCO'.** Kameari, A.; Suzuki, Y.; Ninomiya, H. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 45p. (In Japanese). INIS.

A numerical method for determining the magnetic configuration for MHD equilibrium has been developed, which is used in design of JT-60, a large Tokamak device. The alternating direction implicit method coupled with the 3-step iteration scheme is further improved by addition of the appointment process of plasma parameters (plasma position, shape and current). The code is usable in design of the magnetic field in a toroidal plasma of any shape.

26871 (JAERI-M—6050) **Fundamental block-line diagrams for servo-control of the plasma positions and shape.** Suzuki, Y.; Ninomiya, H.; Kameari, A. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 24p. (In Japanese). INIS.

The fundamental block-line diagrams for servo-control of the plasma positions and shape in JT-60 are presented. The plasma horizontal (vertical) position is controlled by a vertical (horizontal) field and the plasma shape is controlled by a quadrupole field. Magnetic coupling between the coils and shell-effect of the liner are also described.

26872 (LA-UR—76-899) **Explosively produced megagauss fields and applications.** Fowler, C.M.; Caird, R.S.; Garn, W.B.; Erickson, D.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 22p. (CONF-760619—2). Dep. NTIS $3.50.

From Joint international magnetics and magnetism and magnetic materials intermag conference; Pittsburgh, Pennsylvania, United States of America (USA) (15 Jun 1976).

Various explosive magnetic flux compression devices are described that produce pulsed megagauss fields, and a number of applications in which they have been used. Among the systems described are relatively simple ones that generate fields up to 250 T in large fixed volumes, and cylindrical implosion systems that produce fields in excess of 1000 T. Small fixed volume systems are described that may be used in the laboratory. They require only small amounts of explosive and can produce 100 T fields in coils 25 mm long and 10 mm diameter. Measurements were made on various materials in megagauss fields, often at cryogenic temperatures, including magnetoresistance, magnetic susceptability, optical absorption, Faraday rotation, and Zeeman splittings. Experiments are described in which large magnetic pressures have been used to compress solid deuterium isentropically. In flux compression devices part of the energy of the explosives is converted to electromagnetic energy. This has led to their use as compact single-shot high power energy sources. At times, it is necessary to transformer couple loads to the device outputs. The successful operation of transformers in 165 T fields is described.

26873 (MATT—1257) **Observation of magnetic islands in the FM-1 spherator.** Davis, S.L.; Hawryluk, R.J.; Schmidt, J.A. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jun 1976. Contract E(11-1)-3073. 19p. Dep. NTIS $3.50.

Time independent spatially periodic variations in the density and floating potential have been observed in the FM-1 spherator. On the exterior of the plasma/ sup Δn//n and/ sup Δphi//phi are found to be as much as 0.3. Experimental evidence indicates these variations are due to magnetic islands created by small field errors produced by the levitated ring. Calculations of the expected island size agree well with observations.

26874 (ORNL/TM—5333) **Two-dimensional relaxation program for systems with inhomogeneous permeability.** Deeds, W.E.; Dodd, C.V. (Oak Ridge National Lab., Tenn. (USA)). Jun 1976. Contract W-7405-eng-26. 38p. Dep. NTIS $4.00.

A computer program is presented and explained which will solve axially symmetric eddy-current problems, including those with permeable media present. An unusual feature is the combination of coarse and fine lattices, which permit rapid relaxation of coarse lattices in homogeneous regions to be combined with more accurate calculations using a fine lattice in the transition regions where the permeability is varying. Although the actual program listed is restricted to coils encircling a coaxial metal rod, the program can be modified to include any axially symmetric configuration.

26875 (UCRL—50002-75, pp 41-74) **Section 2. Supporting research.** 15 Oct 1975.

In Controlled thermonuclear research. Annual report, July 1974—June 1975.

Supporting research continued on a number of long-range programs. High-lights included the apparently successful use of the "bronze" method for producing multifilamentary Nb_3Sn for high-field superconducing magnets; the experimental confirmation of a technique for high-efficiency direct energy conversion; and the completion of both detailed parametric studies and conceptual system designs of fusion-fission and pure-fusion reactors. Work continued on several aspects of neutral-beam technology, including

the development (in collaboration with Lawrence Berkeley Laboratory) of a 50-A, 40-kV, pulsed neutral beam. Many of the experiments designed to study the damage induced in materials subjected to 14-MeV neutrons were performed in cooperation with other laboratories. In the tritium research program, work began in two areas: development of a method for extracting tritium from the atmosphere of a reactor enclosure, and improvement of tritide targets for the RTNS-II neutron source.

POWER SUPPLIES AND CIRCUITRY

26876 (IPPJ-T—22) **Conceptional design of the vertical field control system in JIPP T-II.** Fujiwara, M.; Itoh, S.; Matsuoka, K.; Matsuura, K.; Miyamoto, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1974. 60p. INIS.

Conceptional design of a system for feedback control of the plasma position in a toroidal discharge is described. It is expected that a resistive shell and an external vertical field controlled by a system consisting of a digital computer and phase-controlled thyristors can suppress the plasma displacement down to 10% of that in the case where the external control system is not operated.

26877 (IPPJ-T—23) **Relativistic electron beam source with an air-core step-up transformer.** Mohri, A.; Ikuta, K.; Masuzaki, M.; Tsuzuki, T.; Fujiwaka, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1975. 18p. INIS.

An air-core step-up transformer with a high coupling factor has been developed to generate a high voltage pulse for charging the pulse forming line of a relativistic electron beam source. A beam source using the transformer was constructed and well operated for the beam injection into a toroidal system.

26878 (LA-UR—76-1203) **Energy storage and transfer with homopolar machine for a linear theta-pinch hybrid reactor.** Vogel, H.F.; Brennan, M.; Dase, W.G.; Tolk, K.M.; Weldon, W.F.;. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 11p. (CONF-760631—6). Dep. NTIS $3.50.

From 9. symposium on fusion technology; Garmisch-Partenkirchen, German, Federal Republic of (F.R. Germany) (14 Jun 1976).

This paper describes the energy storage and transfer system for the compression coils of a linear theta-pinch hybrid reactor (LTPHR). High efficiency and low cost are the principal requirements for the energy storage and transfer of 25 MJ/m or 25 GJ for a 1-km LTPHR. The circuit efficiency must be approximately 90 percent, and the cost for the circuit 5-6 cents/J. Scaling laws and simple relationships between circuit efficiency and cost-per-unit energy as a function of the half cycle time are presented. An important consideration concerns the pulse repetition rate of 2.25 pulses per second, 70 x 10^6 shots/yr, or 1.7 x 10^9 shots over the 25-yr plant life. Current interruption to initiate energy transfer is not feasible at this rate. A simple ringing circuit with contactors to make and break at the periodically occurring zero-current instances is considered.

26879 (LBL—4452) **Shunt regulator for 150-kV, 20-A, 0.5-Sec neutral-beam-source power supplies.** Hopkins, D.B.; Baker, W.R.; Owren, H.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1976. Contract W-7405-ENG-48. 7p. (CONF-760631—7). Dep. NTIS $3.50.

From 9. symposium on fusion technology; Garmisch-Partenkirchen, German, Federal Republic of (F.R. Germany) (14 Jun 1976).

The Lawrence Berkeley Laboratory (LBL) is now constructing a test facility for the development of neutral beam (NB) sources which will operate up to a level of 150 kV, 20A, 0.5 sec with a 1 percent duty cycle [1]. Such sources will provide neutral deuterium beams for injection into large-scale experimental fusion devices. These sources require an accel power supply capable of wide-range variation, voltage regulation of +-1 percent, risetime less than or equal to 20 μsec, turnoff (crowbar) time of less than or equal to 10 μsec, repetitive crowbarring and restarting during a 0.5 sec pulse, and low rate of current increase during a short circuit. A shunt regulator system is described which uses existing components and satisfies these requirements with simplicity and relatively low cost.

26880 (LBL—4473) **Long-pulse neutral beam power supply system for LBL 20 kV, 10 A sources.** Honey, V.J.; Baker, W.R.; Fitzgerald, M.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1976. Contract W-7405-ENG-48. 6p. (CONF-760649—1). Dep. NTIS $3.50.

From Power electronics specialists conference; Cleveland, Ohio, United States of America (USA) (8 Jun 1976).

A description is given of the power supplies and control system for the LBL 20 kV, 10 A, 10 sec long-pulse neutral beam source test facility, now in operation. Such sources are used in a number of existing and planned fusion power experiments.

COOLING SYSTEMS

REFER ALSO TO CITATION(S) 26794, 26862

26881 (BNL—21311) **Heat transfer problems in gas-cooled solid blankets.** Fillo, J.A.; Powell, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. 10p. (CONF-760816—7). Dep. NTIS $3.50.

From National heat transfer conference; St. Louis, Missouri, United States of America (USA) (8 Aug 1976).

In all fusion reactors using the deuterium-tritium fuel cycle, a large fraction approximately 80 percent of the fusion energy will be released as approximately 14 MeV neutrons which must be slowed down in a relatively thick blanket surrounding the plasma, thereby, converting their kinetic energy to high temperature heat which can be continuously removed by a coolant stream and converted in part to electricity in a conventional power turbine. Because of the primary goal of achieving minimum radioactivity, to date Brookhaven blanket concepts have been restricted to the use of some form of solid lithium, with inert gas-cooling and in some design cases, water-cooling of the shell structure. Aluminum and graphite have been identified as very promising structural materials for fusion blankets, and conceptual designs based on these materials have been made. Depending on the thermal loading on the "first" wall which surrounds the plasma as well as blanket design, heat transfer problems may be noticeably different in gas-cooled solid blankets. Approaches to solution of heat removal problems as well as explanation of: (a) the after-heat problems in blankets; (b) tritium breeding in solids; and (c) materials selection for radiation shields relative to the minimum activity blanket efforts at Brookhaven are discussed.

26882 (LA—6362-MS) **Lithium flow on the inside of a spherical fusion-reactor cavity.** Bohachevsky, I.O.; Booth, L.A.; Hafer, J.F. (Los Alamos Scientific Lab., N.Mex. (USA)). May 1976. Contract W-7405-ENG-36. 16p. Dep. NTIS $3.50.

A model is described for steady-state liquid-lithium flow on the inside of a spherical reactor cavity. The governing equations are derived and discussed together with the physical assumptions implicit in the formulation of the problem. Solutions are determined for different distributions and rates of mass supply from the outside through the porous wall to the inside of the cavity. The self-consistency of the model is demonstrated, and from computed flows it is concluded that inside a sphere of 1.5-m radius a liquid layer several millimeters thick can be maintained easily with a circulating flow of only a few kilograms per second. The thickness of the layer can be made nearly uniform over most of the sphere with relatively simple mass-supply distributions. The need for transient stability analysis is pointed out.

26883 (UCRL—78036) **Review of heat transfer problems associated with magnetically-confined fusion reactor concepts.** Hoffman, M.A.; Werner, R.W.; Carlson, G.A.; Cornish, D.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1976. Contract W-7405-Eng-48. 40p. (CONF-760816—3). Dep. NTIS $4.00.

From National heat transfer conference; St. Louis, Missouri, United States of America (USA) (8 Aug 1976).

Conceptual design studies of possible fusion reactor configurations have revealed a host of interesting and sometimes extremely difficult heat transfer problems. The general requirements imposed on the coolant system for heat removal of the thermonuclear power from the reactor are discussed. In particular, the constraints imposed by the fusion plasma, neutronics, structure and magnetic field environment are described with emphasis on those aspects which are unusual or unique to fusion reactors. Then the particular heat transfer characteristics of various possible coolants including lithium, flibe, boiling alkali metals, and helium are discussed in the context of these general fusion reactor requirements. Some specific areas where further experimental and/or theoretical work is necessary are listed for each coolant along with references to the pertinent research already accomplished. Specialized heat transfer problems of the plasma injection and removal systems are also described. Finally, the challenging heat transfer problems associated with the superconducting magnets are reviewed, and once again some of the key unsolved heat transfer problems are enumerated.

FUEL SYSTEMS

26884 (RISO—332) **Pellet acceleration studies relating to the refuelling of a steady-state fusion reactor.** Dimock, D.; Jensen, K.; Jensen, V.O.; Joergensen, L.W.; Pecseli, H.L.; Soerensen, H.; Oester, F. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov 1975. 22p. INIS.

UDC 621.039.6.

Several methods for refuelling a steady state-fusion reactor have been proposed, and the pellet method seems advantageous if the pellet can be accelerated to the necessary velocity. A study group was formed to analyze this acceleration problem. Two pellet velocity values were considered: 10^4 m/s and 300 m/s. A pellet velocity of 10^4m/s may be suitable in the case of a reactor, whereas 300 m/s is believed to be a reasonable velocity at which to perform realistic ablation experiments in the near future. A pneumatic acceleration method was found promising. The pressure is either supplied separately or by evaporation of a part of the pellet. In the latter case, a spark behind the pellet should provide the evoporation and the necessary heating of the driving gas. A preliminary test at room temperature with pellets made of beeswax (the density being ten times that of solid hydrogen, and plastic properties similar to those of solid hydrogen) resulted in a pellet velocity of 100 m/s at a modest value of the energy supplied to the spark.

RADIATION HAZARDS

REFER ALSO TO CITATION(S) 26857

26885 (CONF-760631—4) **Tritium permeation through metals under steam conditions.** Bell, J.T.; Redman, J.D. (Oak Ridge National Lab., Tenn. (USA)). 1976. 8p. Dep. NTIS $3.50.

From 9. symposium on fusion technology; Garmisch-Partenkirchen, German, Federal Republic of (F.R. Germany) (14 Jun 1976).

In fusion reactor power plants the permeation of tritium from the coolant into the steam system must be minimized to prevent release of tritium to the environment. A very promising approach to this requirement is construction of the heat exchanger from a material that will be oxidized by the steam to form an almost impermeable oxide layer on the construction material. Studies of the permeation through nickel have shown that protium permeabilities are 1.6 and 1.5 times greater than tritium permeabilities at 1000 and 700°K, respectively. Studies of the effects of in situ steam oxidation to reduce tritium permeation rates through Incoloy 800 have shown that the tritium permeabilities of some steam generator materials will probably be reduced by the formation of oxide coatings. The effects of severe thermal shock on the oxide coating on Incoloy 800 were observed to destroy the effectiveness of the oxide to impede permeation whereas mild temperature cycling had no effect on the permeation rates.

26886 **There will be no clean fusion.** Gruhier, F. *Sci. Avenir;* No. 346, 1154-1159(Dec 1975). (In French).

It is shown that the fusion reactor often evoked as the ideal "clean" energy source may involve some serious surprises in the field. Indeed, the reaction from which two hydrogen atoms merge to form an helium atom with an energy release does not create itself any radioactive ashes. However the fast neutrons emitted that carry away 80% of the energy, interact with the matter. Some of the atoms from the bombarded materials are converted into radioisotopes of long period that might constitute cumbersome dangerous residues. An ecological problem also arises in relation with the large amounts of tritium to be confined.

POWER CONVERSION SYSTEMS

REFER ALSO TO CITATION(S) 26857, 26875

26887 (BNL—50504) **CONRAD: heat conduction-radiation code. Part I.** Fillo, J.A.; Benenati, R.; Powell, J.R. (Brookhaven National Lab., Upton, N.Y. (USA)). Feb 1976. Contract E(30-1)-16. 56p. Dep. NTIS $4.50.

A computer code is developed for two-dimensional, nonsteady heat conduction in heterogeneous, anisotropic solids with nonuniform volumetric internal heating. Thermal radiation and arbitrary heat flux boundary conditions are accommodated. Coolant tubes are taken into account by prescribing fluid temperatures and heat transfer coefficients. With regard to coolant tubes, allowance is made for: (a) heat capacitance in the tube wall, coolant tube in contact with the structural material; (b) zero heat capacitance in the tube wall, coolant tube in contact with the structural material; and (c) zero heat capacitance in the tube wall, radiation gap between the wall and structure. The finite difference equations are solved by the standard explicit method. Stability as well as convergence of the iterative process are considered.

26888 (CONF-760816—6) **Boiling heat transfer problems in a tokamak.** Fraas, A.P. (Oak Ridge National Lab., Tenn. (USA)). 1976. 17p. Dep. NTIS $3.50.

From National heat transfer conference; St. Louis, Missouri, United States of America (USA) (8 Aug 1976).

A prime incentive to employ a potassium or cesium boiler submerged in a recirculating lithium blanket is that this arrangement gives the most uniform temperature distribution through the blanket and hence the lowest thermal stresses of any configuration that has been proposed. The principal problems currently envisioned are associated with the MHD effects on the liquid feed flow to the boiler tubes and a possibly unsatisfactory boiler feed flow distribution because of the differences in pressure drop in the feed lines from one region to another as a consequence of differences in magnetic field strength and line lengths. Various ways of coping with these problems have been considered and their relative merits have been appraised. The two most promising appear to be the use of a set of EM pumps in a series-parallel arrangement with the EM pumps used to circulate the lithium, and the use of a liner inside the pipes traversing the magnetic field. This liner would consist of a thin layer of electrical insulation covered by a thin layer of the structural material. The principal uncertainty associated with this approach is the extent to which pin holes in the metallic coating over the oxide (zirconia, yttria, thoria, or alumina) cause blistering of the coating.

26889 (UCID—17187) **Energy flux distributions for direct converters.** Devoto, R.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Jul 1976. Contract W-7405-Eng-48. 17p. Dep. NTIS $3.50.

Expressions are derived for the relative ion flux in the fans of a mirror fusion reactor. Numerical values are presented for typical reactor parameters.

INERTIAL CONFINEMENT SYSTEMS

REFER ALSO TO CITATION(S) 26290, 26807

26890 (ANL-HEP—76-14) **Power matching for pellet fusion.** Martin, R.L.; Arnold, R.C. (Argonne National Lab., Ill. (USA)). 12 Feb 1976. Contract W-31-109-Eng-38. 8p. Dep. NTIS $3.50.

The number of beams required for optimum power transfer from a given power source to the surface of a pellet is derived. The result is valid for linear optical systems, hence, for pellet fusion by laser or high energy ion beams. The optimum number of beams turns out to be inconceivably large for any practical system. Practical pellet fusion by lasers or high energy heavy ion beams must thus compromise physical principles in favor of reduced cost and optical complexity.

26891 (INIS-mf—3005) **Coherent nonlinear backscattering by laser-plasma interactions.** Anderson, D.; Wilhelmsson, H. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1974. 44p. INIS.

A theoretical analysis is carried out for the problem of coherent nonlinear backscattering of laser radiation by a high density plasma. A number of effects of direct interest to the DT-pellet fusion research is investigated. A simple physical description is introduced, which relies on a nonlinear potential formulation of the scattering equations. The simplicity and the unified nature of the approach enables one to evaluate and compare the influence on the radiation reflectivity of different effects, such as e.g. inhomogeneities, blow-off velocities, temperature gradients, laser band width and relativistic oscillatory velocities. The understanding of the role played by the various phenomena has consequently improved and it is thought that this approach should be useful for the interpretation of laser-plasma data obtained by computer simulation or laboratory experiments. The results may also be utilized to estimate how and to what extent one may avoid undesired anomalous reflection when planning new laser-plasma devices.

26892 (IPPJ—208) **Numerical analysis on implosion of laser-driven target plasma.** Yabe, T.; Niu, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1974. 34p. INIS.

Implosions of a target pellet exposed to an intense laser light are investigated numerically by using the spherically symmetric hydrodynamic equations. In order to obtain the maximum out put of the fusion energy from the pellet, the following facts are pointed out: (1) There is the optimum value of the laser intensity: (2) It is effective to replace the outside part of the critical density of the target plasma by a substance with a heavier particle mass: (3) For large pellets, a larger laser power is efficient: (4) There is the optimum shape of the laser pulse: (5) More out put energy is yielded from a pellet with a larger radius when the power and the pulse shape of the laser light are optimum.

26893 (LA—6189-MS) **Some effects of laser irradiation on aluminum.** Hoffman, C.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Dec 1975. Contract W-740.-eng-36. 25p. Dep. NTIS $4.00.

Ten samples of aluminum were irradiated by a 1.06-μm mode-locked laser (25 ps) to various energy levels. The excavations were examined by optical and scanning electron microscopy. Rough computations of the mass of metal removed indicated a relationship of energy of the laser shot to the mass removed as about 9 J/mole. In some cases there is good evidence to indicate compression of the metal, but no values for this compression could be obtained.

26894 (LA—6420-MS) **Dependence of laser-driven compression efficiency on wavelength.** McCrory, R.L.; Morse, R.L. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1976. Contract W-7405-Eng-36. 5p. Dep. NTIS $3.50.

Numerical simulations of laser-driven implosions combined with previously derived scaling laws, both based on classical thermal conduction without any flux limiting, indicate that the absorbed energy required to cause a given implosion, and, therefore, the anticipated nuclear yield ratio should scale approximately inversely with wavelength in the visible and near infrared.

26895 (SAND—76-0148) **Electron-beam-fusion progress report, 1975.** (Sandia Labs., Albuquerque, N.Mex. (USA)). Jun 1976. Contract AT(29-1)-789. 122p. Dep. NTIS $5.50.

Summaries of research work are given on electron sources, insulation problems, and power supplies. Some theoretical work is reported on fusion target design, self-consistent deposition and hydrodynamic calculations, analysis of x-ray pinhole data, diode code calculations, magnetically insulated diodes and transmission lines, ion sheath motion in plasma-filled diodes, relativistic distribution functions, macroscopic properties, and kinetic theory, heavy ion pulsed fusion, and collective ion acceleration. Some experimental work on targets, diode physics, and diagnostic developments is given. (MOW)

26896 (SAND—76-5316) **Nuclear-pumped laser concepts for laser fusion or laser-heated solenoid reactors.** McArthur, D.A.; Walker, J.V. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1976. Contract AT(29-1)-789. 13p. (CONF-760438—4). Dep. NTIS $3.50.

From Workshop on nuclear pumped laser; Monterey, California, United States of America (USA) (6 Apr 1976).

The combination of a nuclear-pumped laser with a fusion reactor, using some of the neutrons emitted from the fusion reactor to pump the laser, is described. This paper describes several concepts which might be used, points out potential advantages of using a nuclear-pumped laser, and describes several areas which must be investigated to prove feasibility. (MOW)

26897 (UCRL—74484) **General remarks concerning some laser-initiated fusion proposals.** Wood, L.; Nuckolls, J.; Zimmerman, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1971. 9p. (CONF-711160—2). Dep. NTIS $3.50.

From American Physical Society meeting; Madison, Wisconsin, USA (15 Nov 1971).

The advent of very high power, high energy pulsed laser systems has stimulated considerable thinking regarding how such systems might be used to engender thermonuclear microexplosions, and, in particular, explosions which may produce more energy than the inputted laser energy or even more energy than that used to pump the laser. Some of the basic physical principles and processes constraining laser-CTR proposals will be discussed, and application of them made to establish basic levels of feasibility of these published types of CTR schemes. It is demonstrated that this class of thermonuclear microexplosions has no potential CTR utility with lasers likely to be available in the next few years.

26898 (UCRL—74485) **Calculational results concerning some laser-initiated fusion proposals.** Zimmerman, G.; Nuckolls, J.; Wood, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1971. 17p. (CONF-711160—3). Dep. NTIS $3.50.

From American Physical Society meeting; Madison, Wisconsin, USA (15 Nov 1971).

Some proposals appearing in the literature of laser-initiated thermonuclear fusion microexplosions which assertedly produce about as much thermonuclear energy as was inputted in laser light have been evaluated on physics simulation computer codes. These codes simulate in considerable detail the physical processes deemed to be relevant in such proposed schemes to produce a time history of the proposed microexplosion system. Output of such codes will be presented to demonstrate that the thermonuclear performance of such systems fall far short of approximation-rich analytic estimates, and the role of such approximations in producing such discrepancies is briefly discussed.

26899 (UCRL—76980) **Development scenario for laser fusion.** Maniscalco, J.A.; Hovingh, J.; Buntzen, R.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Mar 1976. Contract W-7405-Eng-48. 57p. (CONF-751101—91).

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

This scenario proposes establishment of test and engineering facilities to (1) investigate the technological problems associated with laser fusion, (2) demonstrate fissile fuel production, and (3) demonstrate competitive electrical power production. Such facilities would be major milestones along the road to a laser-fusion power economy. The relevant engineering and economic aspects of each of these research and development facilities are discussed. Pellet design and gain predictions corresponding to the most promising laser systems are presented for each plant. The results show that laser fusion has the potential to make a significant contribution to our energy needs. Beginning in the early 1990's, this new technology could be used to produce fissile fuel, and after the turn of the century it could be used to generate electrical power.

26900 (UCRL—77700) **Focusing lenses for the 20-beam fusion laser, SHIVA.** O'Neal, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 May 1976. Contract W-7405-Eng-48. 34p. (CONF-760513—8). Dep. NTIS $4.00.

From 22. international instrumentation of the Instrument Society of America; San Diego, California, United States of America (USA) (25 May 1976).

The focus lens design for the 20-beam SHIVA laser fusion facility involves considerations of uniform and normal pellet illumination. The resulting requirements dictate tailored beam intensity profiles and vacuum-loaded thin lenses.

26901 (UCRL—77725) **Laser fusion overview.** Nuckolls, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 May 1976. Contract W-7405-Eng-48. 26p. (CONF-760611—7). Dep. NTIS $4.00.

From International conference on quantum electronics and exhibition; Amsterdam, Netherlands (14 Jun 1976).

Because of recent breakthroughs in the target area, and in the glass laser area, the scientific feasibility of laser fusion—and of inertial fusion—may be demonstrated in the early 1980's. Then the development in that time period of a suitable laser (or storage ring or other driving source) would make possible an operational inertial fusion reactor in this century. These are roughly the same time scales as projected by the Tokamak magnetic confinement approach. It thus appears that the 15-20 year earlier start by magnetic confinement fusion may be overcome. Because inertial confinement has been demonstrated, and inertial fusion reactors may operate on smaller scales than Tokamaks, laser fusion may have important technical and economic advantages.

26902 (CONF-751108—19) **Experimental investigation of focusing and transport of heavy-current electron beams.** Baranchikov, E.I.; Gordeev, A.V.; Koba, Yu.V.; Korolev, V.D.; Pen'kina, V.S.; Rudakov, L.I.; Smirnov, V.P.; Sukhov, A.D.; Tarumov, E.Z. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. Translation of a Russian paper. 14p. Dep. NTIS $3.50.

From 1. international topical conference on electron beam research and technology; Albuquerque, New Mexico, USA (3 Nov 1975).

The results of an experimental and theoretical study of beam transfer through transverse magnetic fields are outlined. The injection and transport of an annular relativistic electron beam due to a magnetic trap of acute-angle geometry are experimentally studied. (MOW)

26903 **Fuel configuration for and a method of achieving the controlled release of thermonuclear energy.** Brueckner, K.A. (to KMS Fusion, Inc.). Canadian Patent 972874. 12 Aug 1975. 30p.

Available from Commissioner of Patents, Ottawa.

A fuel configuration for and a method of achieving the controlled release of thermonuclear energy by illuminating a minute, solid density, sphere or spherical shell of a mixture of deuterium and tritium at solid density with a high intensity, uniformly converging laser wave to effect an extremely rapid build-up of energy in inwardly traveling shock waves to implode the fuel creating thermonuclear conditions causing a reaction of deuterons and tritons and a resultant high energy thermonuclear burn. Utilizing the resulting energy as a thermal source and to breed tritium. The invention also contemplates a laser source wherein the flux level is increased with time to reduce the initial shock heating of fuel and provide maximum compression after implosion.

26904 **Tolerance of laser-driven microshell targets to fluorescence and prepulse energy.** Leonard, T.; Moncur, N.K.; Sullivan, D. (KMS Fusion Inc., Box 1567, Ann Arbor, Michigan 48106). *J. Appl. Phys.*; 47: No. 9, 4021-4023(Sep 1976).

Glass-shell targets currently being used for laser-fusion experiments are susceptible to damage by preenergy from the laser.

This energy can result from amplified spontaneous emission (ASE) throughout the laser chain during the period of high-population inversion or it can take the form of a short prepulse nanoseconds before the main laser pulse. We point out the energy levels which a typical target can tolerate in the form of ASE and prepulses. These energies are low enough that special precautions must be taken to prevent significant perturbations of the target or its environment before the main laser pulse. (AIP)

COMPONENT DEVELOPMENT AND TESTING

REFER ALSO TO CITATION(S) 26122, 26144, 26145, 26146, 26208, 26364, 26875

26905 (BNWL—1939-3, pp 17-50) **Materials research and radiation environment simulation.** Apr 1976.

In Pacific Northwest Laboratory report on Controlled Thermonuclear Reactor Technology, January 1976—March 1976.

In the surface effects studies data has been obtained on the lattice dynamical neutron sputtering ratio for niobium and gold. The ratios are on the order of 10^{-3} atoms/neutron. The effect of the implanted ion on the microstructure of ion bombarded molybdenum is currently being studied. Void nucleation in nickel has been examined in specimens bombarded simultaneously with He^{+} and Ni^{2+} ions. Thin graphite cloth samples irradiated to a neutron fluence of about 3×10^{21} cm^{-2} at approximately 500°C shrank approximately 8 percent in the axial direction of the fiber, yet they accommodated this shrinkage with no visual deterioration. The effect of low contaminant level, high pressure, high temperature helium on the mechanical and corrosion properties of CTR structural materials is being studied. Currently five near term alloys are being exposed to lightly contaminated helium at 650°C and 300 psi in two autoclaves. The effect of helium on the refractory metals niobium and vanadium in the annealed and cold-worked states is being determined. An evaluation of the electrical resistivity and dielectric breakdown behavior of selected samples of sputter-deposited SiO_2 was performed.

26906 (CONF-760631—2) **Vacuum pumping for controlled thermonuclear reactors.** Watson, J.S.; Fisher, P.W. (Oak Ridge National Lab., Tenn. (USA)). 1976. 10p. Dep. NTIS $3.50.

From 9. symposium on fusion technology; Garmisch-Partenkirchen, German, Federal Republic of (F.R. Germany) (14 Jun 1976).

Thermonuclear reactors impose unique vacuum pumping problems involving very high pumping speeds, handling of hazardous materials (tritium), extreme cleanliness requirements, and quantitative recovery of pumped materials. Two principal pumping systems are required for a fusion reactor, a main vacuum system for evacuating the torus and a vacuum system for removing unaccelerated deuterium from neutral beam injectors. The first system must pump hydrogen isotopes and helium while the neutral beam system can operate by pumping only hydrogen isotopes (perhaps only deuterium). The most promising pumping techniques for both systems appear to be cryopumps, but different cryopumping techniques can be considered for each system. The main vacuum system will have to include cryosorption pumps cooled to 4.2°K to pump helium, but the unburned deuterium-tritium and other impurities could be pumped with cryocondensation panels (4.2°K) or cryosorption panels at higher temperatures. Since pumping speeds will be limited by conductance through the ducts and thermal shields, the pumping performance for both systems will be similar, and other factors such as refrigeration costs are likely to determine the choice. The vacuum pumping system for neutral beam injectors probably will not need to pump helium, and either condensation or higher temperature sorption pumps can be used.

26907 (CONF-760631—5) **Radiation transport and shielding information, computer codes, and nuclear data for use in CTR neutronics research and development.** Santoro, R.T.; Maskewitz, B.F.; Roussin, R.W.; Trubey, D.K. (Oak Ridge National Lab., Tenn. (USA)). 1976. 6p. Dep. NTIS $3.50.

From 9. symposium on fusion technology; Garmisch-Partenkirchen, German, Federal Republic of (F.R. Germany) (14 Jun 1976).

The activities of the Radiation Shielding Information Center (RSIC) of the Oak Ridge National Laboratory are being utilized in support of fusion reactor technology. The major activities of RSIC include the operation of a computer-based information storage and retrieval system, the collection, packaging, and distribution of large computer codes, and the compilation and dissemination of processed and evaluated data libraries, with particular emphasis on neutron and gamma-ray cross-section data. The Center has acquired thirteen years of experience in serving fission reactor, weapons, and accelerator shielding research communities, and the extension of its technical base to fusion reactor research represents a logical progression. RSIC is currently working with fusion reactor researchers and contractors in computer code development to provide tested radiation transport and shielding codes and data library packages. Of significant interest to the CTR community are the 100 energy group neutron and 21 energy group gamma-ray coupled cross-section data package (DLC-37) for neutronics studies, a comprehensive 171 energy group neutron and 36 energy group gamma-ray coupled cross-section data base with retrieval programs, including resonance self-shielding, that are tailored to CTR application, and a data base for the generation of energy-dependent atomic displacement and gas production cross sections and heavy-particle-recoil spectra for estimating radiation damage to CTR structural components.

26908 (LA—6162-MS) **Fabrication of a segmented composite stainless steel-alumina discharge tube for a theta-pinch coil.** Dickinson, J.M.; Stoddard, S.D.; Muller, J.F. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1975. Contract W-7405-eng-36. 14p. Dep. NTIS $3.50.

An 80-mm-diam segmented discharge tube that simulated in a simplified way the blanket and first wall of the Reference Theta-Pinch Reactor (RTPR) has been constructed. The segments were fabricated by plasma-arc spraying an alumina coating on tubular stainless steel trapezoids. These were laid up to form a cylinder that was contained in a fully dense alumina vacuum tube. The fabrication processes are discussed in detail.

26909 (LA-UR—76-892) **Heat transfer problems associated with laser fusion.** Frank, T.G.; Bohachevsky, I.O.; Booth, L.A.; Pendergrass, J.H. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 9p. (CONF-760816—2). Dep. NTIS $3.50.

From National heat transfer conference; St. Louis, Missouri, United States of America (USA) (8 Aug 1976).

Briefly discussed are the laser-initiated fusion reaction, emissions that are produced, and methods that may be used to protect the walls of reactor cavities from these emissions. Thermal loadings encountered in laser fusion reactors will consist of energy deposition by discrete, short, intense pulses of x and gamma rays, fast alpha and other charged particles, and fusion neutrons. Presented are models of energy deposition in structural walls and blanket regions surrounding the reaction chamber and methods used to calculate resulting temperature increases and thermal stresses in these components. The results of such calculations indicate that the design conditions for the engineering of laser-initiated fusion reactors will be severe and a great amount of ingenuity and analysis will be required to meet them successfully.

26910 (LA-UR—76-1136) **Electrical insulators for the theta-pinch fusion reactor.** Clinard, F.W. Jr. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-ENG-36. 22p. (CONF-760558—3). Dep. NTIS $3.50.

From CTR insulator meeting; Los Alamos, New Mexico, United States of America (USA) (17 May 1976).

The five major applications for electrical insulators in the Reference Theta Pinch Reactor are as follows: (1) first-wall insulator, (2) blanket intersegment insulator, (3) graphite encapsulating insulator, (4) implosion coil insulator, and (5) compression coil insulator. Insulator design proposals and some preliminary test results are given for each application. (MOW)

26911 (LA-UR—76-1297) **D.B.S. in disordered insulators.** Bunch, J.M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1976. Contract W-7405-Eng-36. 11p. (CONF-760558—5). Dep. NTIS $3.50.

From CTR insulator meeting; Los Alamos, New Mexico, United States of America (USA) (17 May 1976).

These studies were undertaken in order to determine insulator properties for the CTR program. Most of the d.b.s. studies so far have been with various forms of Al_2O_3. Some work using fission neutrons and 15-MeV protons along with some high-energy heavy ions is briefly described. Attempts to measure d.b.s. and other electrical properties are mentioned. (MOW)

26912 **Lithium's role in supplying energy in the future.** Borg, I.Y.; O'Connell, L.G. (Univ. of California, Livermore). *Energy Sources;* **2**: No. 4, 347-359(1976).

Lithium's unusual properties as a metal have propelled it into the forefront of materials destined to play an important role in the economy of the next century. It promises to be an important component of the breeder blanket of controlled thermonuclear reactors as well as hybrid fission-fusion reactors that may serve to transmute high-level waste generated by conventional fission reactors. About 100 to 1000 kg of natural lithium are required per megawatt-electric. Lithium-water-air and lithium-sulfide batteries have been tested and show great promise of becoming the batteries

for electric automobiles in the future. One of these batteries can just as well serve for local off-peak energy storage in the utility industry. Similarly, they can be used for intermittent energy sources (wind, tidal, and solar power). The current lithium reserves and resources will be hard put to meet customary demands for lithium, which are increasing at a rate of 8 to 10 percent/yr, so the U.S. supply will have to be expanded by increased exploration. (34 references)

GENERAL AND MISCELLANEOUS

26913 (INIS-mf—3067) **Survey of the technical-scientific research field in the Oslo district.** (Oslo Univ. (Norway); Norges Teknisk-Naturvitenskapelige Forskningsraad, Oslo). Dec 1975. 155p. (In Norwegian). INIS.

Organisations and institutes in the Oslo district which carry out research in the technical-scientific field are listed, with address and telephone number. This includes a number of institutes whose activities are mainly or partly in the nuclear field. The list is subdivided into departments, with brief descriptions of their fields of activity, the scientific personnel with their special interests, and a detailed list of the special projects and activities of the departments. Special apparatus and equipment which the institutes have at their disposal are also mentioned with brief specifications.

MANAGEMENT

26914 (INIS-mf—2028) **Danish Atomic Energy Commission annual report, 1 April 1974—31 March 1975.** (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1975. 165p. (In Danish). INIS.

With list of staff publications.

Activities of the Danish Atomic Energy Commission and the Risoe Research Establishment for the period April 1, 1974 to March 31, 1975 are summarized. The operations of the various facilities at the Research Establishment are revised. Operating staff levels and financial data are tabulated, and a list of staff publications is given.

26915 (INIS-mf—2073) **Danish Atomic Energy Commission 1974/75. Nineteenth annual report.** (Atomenergikommissionen, Copenhagen (Denmark)). Nov 1975. 79p. INIS.

With selected list of staff publications.

Activities of the Danish Atomic Energy Commission and the Risoe eesearch Establishment for the period April 1, 1974 to March 31, 1975 are summarized. The operations of the various facilities at the Research Establishment are revised. Operating staff levels and financial data are tabulated, a selected list of staff publications is given, and the design data on research facilities are presented.

26916 (INIS-mf—3043) **CSIRO twenty-seventh annual report, 1974/75.** (Commonwealth Scientific and Industrial Research Organization, Canberra (Australia)). 1975. 75p. INIS.

Research programs includes topics such as soil science, agriculture, food science, pest control, solar energy, atmospheric phenomena, and surface properties of solids and the solid state. Finance and building details are listed and a chart of the organizational structure of CSIRO is given.

26917 (INIS-mf—3065) **AEB highlights.** (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Jan 1975. 5p. INIS.

AEB HIGHLIGHTS is a half-yearly report reflecting the most important recent achievements of the various Research and Technical Divisions of the Atomic Energy Board. It appears alternately in English and Afrikaans.

26918 (RISO-M—1834) **Research on alternative forms of energy.** Linderstroem-Lang, C.U.; Neltrup, H.; Fritz-Rasmussen, S.B.; Christensen, C.J.; Vigeholm, B.; Rasmussen, I. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1976. 117p. (In Danish). INIS.

Survey of Risoe's possibilities for contributing to research and development relating to forms of energy other than those already dealt with by the Establishment.

26919 (SAND—76-0059) **Sandia technology, Winter 1975—1976.** Weber, J.P.; Marcrum, L.S. (eds.). (Sandia Labs., Albuquerque, N.Mex. (USA)). Jun 1976. Contract AT(29-1)-789. 34p. Dep. NTIS $5.00.

Unclassified development activities at Sandia Laboratories are described. Information is included on rocket-powered aerial trolleys, material evaluation using a plasmajet, metal-hydride models, glass-ceramic tube insulators, ferroelectric ceramics, and systems to communicate with earth penetrators. (JRD)

26920 (UCRL—52000-76-4) **Energy and technology review.** Carr, R.B.; Crawford, R.B.; McCaleb, C.S.; Prono, J.K. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1976. Contract W-7405-Eng-48. 26p. Dep. NTIS $4.00.

Research is reported on in-situ coal gasification, holography, computer security, and asbestos monitoring in air. Separate entries were made for the four sections of the report.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 26382, 26698

26921 (COO—2280-12) **Application of relaxation techniques to the factorization of iterative procedures. Progress report.** Beauwens, R. (Northwestern Univ., Evanston, Ill. (USA)). May 1976. Contract E(11-1)-2280. 51p. Dep. NTIS $4.50.

Relaxation techniques which have been used in connection with the factorization iterative methods are reviewed. Known properties are summarized, and new ones are obtained. A precise meaning is given to the notion of iterative procedures of order q, and the two-parameters overrelaxation technique of Woznicki is shown to be a factorization iterative method of the second order; some consequences of this fact are developed. Other results include the refinement of known properties of the extrapolation principle and estimations of the powers of the Oliphant relaxation technique for consistently ordered matrices and of the Chebyshev technique for Stieltjes. 4 figures.

26922 (COO—2280-24) **TWO-STEP: user's guide (computer program for CDC 6400).** Bareiss, E.H.; Kobbe, R. (Northwestern Univ., Evanston, Ill. (USA). Dept. of Computer Sciences). Apr 1976. Contract E(11-1)-2280. 16p. Dep. NTIS $3.50.

A guide for the use of the CDC-6400 Computer Program TWO-STEP for the exact solution of linear matrix equations over the integral domain is given. The rational result is converted into decimal form to 12 decimal places.

26923 (LA—6428-MS) **Fixed increment algorithm in pattern recognition.** Everett, C.J.; Cashwell, E.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Jun 1976. Contract W-7405-ENG-36. 3p. Dep. NTIS $3.50.

A detailed proof is given that the "fixed increment" algorithm of pattern recognition theory succeeds in producing, in a finite number of steps, a set of hyperplanes which separate (with buffer zones) a given finite number of linearly separable, finite sets of vectors. The basic algorithm and theorem have been disentangled from existing proofs, and appear as general properties of any inner product space.

26924 (LA—6449-MS) **Iteration of the number-theoretic function f(2n) = n, f(2n + 1) = 3n + 2.** Everett, C.J. (Los Alamos Scientific Lab., N.Mex. (USA)). Jul 1976. Contract W-7405-eng-36. 7p. Dep. NTIS $3.50.

It is a long-standing conjecture that, under iteration of the number-theoretic function f(2n) = n, f(2n + 1) = 3n + 2, every integer m has an iterate f/sup k/(m) = 1. Since virtually nothing is known about the question, save that it seems to be true for m up to the millions, it may be of interest to know that almost every m has an iterate f/sup k/(m) less than m, a result proved in the present report.

26925 (ORNL/CSD—8) **Optimal incomplete block designs.** Mitchell, T.J.; John, J.A. (Oak Ridge National Lab., Tenn. (USA)). Jun 1976. Contract W-7405-eng-26. 33p. Dep. NTIS $4.00.

A classical problem in experimental design is the construction of incomplete block designs, i.e., designs that group r replications of each of v treatments into b blocks of size k. This report presents optimal incomplete block designs which were constructed utilizing the connection between the concurrence matrix of a design and a regular graph. The class of regular graph (RG) designs, conjectured to be optimal, is defined. The results of a systematic search of the class of RG designs are given for all cases in which v is less than or equal to 12 and r is less than or equal to 10. In nearly every case, the optimum design with respect to each of the three criteria, D-optimality, A-optimality (identical with) = efficiency and E-optimality, is determined. Many of these designs are new and are tabulated in this report. 2 tables.

26926 (ORO—3443-60) **Stucies of the numerical solution of elliptic parabolic boundary value problems.** Babuska, I. (Maryland

Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). 1976. Contract AT(40-1)-3443. 6p. Dep. NTIS $3.50.

Research progress in the following areas is summarized in a nontechnical manner: self-adaptive approach in the finite element method and related topics; problems arising from composite materials (homogenization); and the finite element approach to boundary-value problems of mixed type and related topics. (RWR)

26927 (SU—326-P30-46) **Hybrid conjugate gradient algorithms.** O'Leary, D.P. (Stanford Univ., Calif. (USA). Dept. of Computer Science). Mar 1976. Contract E(04-3)-326. 118p. Dep. NTIS $5.50.

Thesis.

The conjugate gradient algorithm is a standard iterative technique for solving systems of linear and nonlinear equations. This report deals with the development of computationally efficient and more stable variations of the standard conjugate gradient algorithm for problems in which the Jacobian matrix is symmetric and positive definite. Specific applications considered are associated with the solution of finite difference discretizations of elliptic partial differential equations. The applications are in the fields of hydrodynamics and stress analysis; simple numerical examples are given concerning water seepage through a porous earthen dam, the pressure distribution on the lubricant surrounding a journal bearing, and the behavior of the cross section of a rectangular bar under torsion. 3 figures, 9 tables. (RWR)

26928 (UCRL—52000-76-4, pp 12-17) **RISOS: a study of computer security.** Apr 1976.

In Energy and technology review.

The Research in Secured Operating Systems (RISOS) project was initiated in April 1972 because of concerns about the vulnerability of computer systems in protecting information sensitive to the national defense. Under contract to the Advanced Research Projects Agency (ARPA) of the Department of Defense, the Laboratory established a special team of computer scientists to develop methods for testing the security of data stored in computers and to examine the security of selected commercial operating systems. In both cases, the focus was on software rather than physical security. We established seven major classifications of security flaws and developed both analytic tools and a methodology for evaluating the security of operating systems. 2 figures.

26929 (UCRL-Trans—11097) **Method of finite differences as applied to parabolic differential equations.** Albrecht, J. Translated from *Z. Angew. Math. Mech.;* **37**: No. 5/6, 202-212(1957). 25p. Dep. NTIS $3.50.

The finite difference method as applied to differential equations (heat conduction and bar vibration equations) is discussed. The following aspects are examined: the relationship between stability, step size in time-direction, and position of the lattice points employed; accuracy ("mehrstellen method"); curved boundaries; the Runge—Kutta principle. 3 figures, 3 tables.

26930 **Algorithms to reveal the representation of characters, integers, and floating-point numbers.** George, J.E. (Los Alamos Scientific Lab., NM). *ACM Trans. Math. Software;* 1: No. 3, 210-216(Sep 1975).

Three algorithms are presented as a set of Standard Fortran subroutines which compute the number of characters representable in a single storage unit, the number of bits representing a character, and the type of integer representation. This information provides for the determination of a lower bound for the floating-point exponent length. The method used for the computations is rarely discussed in the literature of programing techniques and is applicable to other languages. The assumptions of the algorithm and the accuracy of the results are discussed. 1 table.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 25393, 26560

26931 (UCRL—50038—76-1) **Research leading to the production and early use of numeric data banks of material properties and system analyses. First quarterly progress report, January—March, 1976.** Henry, E.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 May 1976. Contract W-7045-Eng-48. 18p. Dep. NTIS $3.50.

Under contract with ERDA's Division of Energy Storage, research was initiated leading to creation of a numerical data base of material properties. In the period January-March 1976 a list of tasks to be completed was compiled and a literature survey in energy storage, flywheel rotor materials, and battery-storage systems was started.

CIVILIAN DEFENSE

REFER ALSO TO CITATION(S) 26460

26932 (AD-A—010630) **Experimental verification of ventilation analysis procedure. Final report.** Burns, J.J. Jr. (Army Construction Engineering Research Lab., Champaign, Ill. (USA)). Apr 1975. 43p. (CERL-TR-C—29). NTIS $3.75.

This report represents the results of an experiment to verify the adequacy of a supplement to ER 1190-1-2 and TR 20 (Volume 3), the Technical Manual for Ventilation Analysis Procedure. The purpose of the experiment was to predict the rate of induced air flow through a fallout shelter. The only applied force in the shelter is the sensible heat given off by its occupants. Induced air flows through three model chambers containing resistance heaters that simulated body heat air-flow speeds from 10 to 30 fpm were measured using thermistors. After demonstrating that the model test results would be similar to the flows expected in larger shelters of a similar geometry, test runs involving one and two chamber wall cutouts were conducted. (GRA)

CORPORATE INDEX

In the corporate index, technical report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

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Assessment of the applicability of automotive emission control technology to stationary engines. Final report, 1:26023 (PB—237115)
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Assessment and study of existing concepts and methods of cryogenic refrigeration for superconducting transmission cables. Progress report, 1 November 1975—31 December 1975, 1:25719 (COO—2552-5)

Air Products and Chemicals, Inc., Marcus Hook, Pa. (USA)
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The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

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CONF-750720-	1:25987	Dep. NTIS, $9.25
CONF-750768-		
1	1:26369	*See* LBL-4826
CONF-750824-		
16	1:26258	*See* BNL-21538
CONF-750929-		
4	1:26484	Dep. NTIS, $4.00
CONF-750952-		
5	1:26124	*See* HEDL-SA-1011
CONF-7509115-		
1	1:26363	*See* TM-609
CONF-7510107-		
3	1:26125	*See* HEDL-SA-1039
CONF-7510110-		
1	1:26655	*See* UR-3490-815
CONF-751101-		
91	1:26899	*See* UCRL-76980
CONF-751108-		
19	1:26902	Dep. NTIS, $3.50
CONF-751119-		
3	1:25700	*See* UCRL-77905
CONF-751181-	1:25573	Dep. NTIS, $10.00
CONF-751239-		
(Absts.)	1:25720	*See* INIS-mf-3025
(Absts.)	1:25724	*See* INIS-mf-3025
(Absts.)	1:25723	*See* INIS-mf-3025
(Absts.)	1:25722	*See* INIS-mf-3025
(Absts.)	1:25721	*See* INIS-mf-3025
(Absts.)	1:25734	*See* INIS-mf-3025
(Absts.)	1:25726	*See* INIS-mf-3025
(Absts.)	1:25725	*See* INIS-mf-3025
(Absts.)	1:25816	*See* INIS-mf-3025
(Absts.)	1:25780	*See* INIS-mf-3025
(Absts.)	1:25781	*See* INIS-mf-3025
(Absts.)	1:25804	*See* INIS-mf-3025
(Absts.)	1:25805	*See* INIS-mf-3025
(Absts.)	1:25783	*See* INIS-mf-3025
(Absts.)	1:25806	*See* INIS-mf-3025
(Absts.)	1:25782	*See* INIS-mf-3025
(Absts.)	1:25807	*See* INIS-mf-3025
(Absts.)	1:25784	*See* INIS-mf-3025
(Absts.)	1:25743	*See* INIS-mf-3025
CONF-760128-		
2	1:26783	*See* MATT-1191
CONF-760132-	1:25525	Institute of Gas Technology (1976). $40.00
CONF-760133-		
1	1:25920	*See* SAND-76-5155

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CONF-760206-3	1:25647	*See* SAND-76-5141
CONF-760210-3	1:26474	*See* LA-UR-76-1335
CONF-760342-1	1:26033	*See* UCRL-78066
2	1:25947	*See* UCRL-78153
3	1:25385	Dep. NTIS, $3.50
4	1:25382	Dep. NTIS, $3.50
5	1:25386	Dep. NTIS, $3.50
CONF-760343-1	1:26863	*See* BNL-21158
2	1:26857	*See* GA-A-13896
CONF-760348-1	1:26156	*See* MLM-2334(OP)
CONF-760350-1	1:26174	*See* BNL-21513
CONF-760416-2	1:25892	Dep. NTIS, $3.50
CONF-760424-11	1:26743	*See* LA-UR-76-830
15	1:26735	*See* BNL-21199
CONF-760435-4	1:25940	*See* BNWL-SA-5677
CONF-760438-4	1:26896	*See* SAND-76-5316
CONF-760439-	1:25443	*See* LA-6358-C
CONF-760445-4	1:26615	*See* COO-3380-23
CONF-760455-1	1:26253	*See* BNL-21307
CONF-760457-1	1:26354	*See* SAND-76-5286
CONF-760461-1	1:26485	Dep. NTIS, $3.50
CONF-760464-2	1:26072	Dep. NTIS, $3.50
6	1:26071	*See* BNL-21410
7	1:26138	*See* LA-UR-76-1535
CONF-760469-2	1:26856	*See* GA-A-13883
3	1:25902	Dep. NTIS, $3.50
CONF-760470-1	1:26594	Dep. NTIS, $3.50
CONF-760502-2	1:26291	*See* SAND-76-5170
CONF-760503-3	1:25761	Dep. NTIS, $3.50
5	1:26208	Dep. NTIS, $3.50
6	1:25849	Dep. NTIS, $3.50
7	1:25850	Dep. NTIS, $3.50
9	1:25851	Dep. NTIS, $3.50
12	1:25852	Dep. NTIS, $3.50
CONF-760513-8	1:26900	*See* UCRL-77700
9	1:26808	*See* UCRL-78235
CONF-760515-3	1:26122	Dep. NTIS, $3.50
CONF-760524-3	1:26195	*See* UCRL-78347
CONF-760530-2	1:26123	Dep. NTIS, $4.00
CONF-760532-3	1:26255	*See* DP-MS-75-119
CONF-760540-3	1:26039	*See* LA-UR-76-1150
5	1:26040	*See* NLCO-1134
CONF-760543-1	1:26046	*See* BNL-21505
CONF-760549-1	1:25570	*See* BNWL-SA-5808
CONF-760551-1	1:25687	*See* SAND-76-5535
CONF-760553-1	1:26424	*See* COO-1340-50
2	1:26423	*See* COO-1340-49
CONF-760557-1	1:26560	*See* LA-UR-76-1417
CONF-760558-1	1:26145	*See* LA-UR-76-1131
2	1:26144	*See* LA-UR-76-1134
3	1:26910	*See* LA-UR-76-1136
4	1:26146	*See* LA-UR-76-1298
5	1:26911	*See* LA-UR-76-1297
CONF-760561-2	1:26713	*See* LA-UR-76-1197
4	1:26368	*See* LA-UR-76-1178
5	1:26731	*See* LA-UR-76-1183
CONF-760570-1	1:25615	*See* LA-UR-76-1561
CONF-760601-6	1:26207	*See* BNL-21470
CONF-760611-7	1:26901	*See* UCRL-77725
CONF-760615-7	1:25496	*See* BNWL-SA-5836
CONF-760618-2	1:26003	Dep. NTIS, $3.50
CONF-760619-2	1:26872	*See* LA-UR-76-899
CONF-760620-3	1:26229	*See* LA-UR-76-727
CONF-760621-2	1:26862	*See* BNL-20725
CONF-760622-6	1:26752	*See* COO-2458-9
30	1:26866	*See* UCRL-77887
33	1:25854	*See* DP-MS-76-16
35	1:25791	*See* DP-MS-76-7
39	1:25741	Dep. NTIS, $3.50
CONF-760631-2	1:26906	Dep. NTIS, $3.50
4	1:26885	Dep. NTIS, $3.50
5	1:26907	Dep. NTIS, $3.50
6	1:26878	*See* LA-UR-76-1203
7	1:26879	*See* LBL-4452
CONF-760632-2	1:26579	Dep. NTIS, $3.50
CONF-760635-1	1:26839	*See* LBL-5201
2	1:26807	*See* UCRL-77730
3	1:26838	*See* LBL-5200
CONF-760646-1	1:25861	*See* LA-UR-76-1432
CONF-760647-1	1:26740	*See* LA-UR-76-1383
CONF-760648-1	1:25978	Dep. NTIS, $3.50
CONF-760649-1	1:26880	*See* LBL-4473
CONF-760650-1	1:26292	*See* SAND-76-5542
CONF-760651-(Absts.)	1:26206	National Science Foundation, Washington, DC
CONF-760662-1	1:26254	*See* BNL-21594
CONF-760701-4	1:25472	*See* HEDL-SA-851
5	1:25473	*See* HEDL-SA-856
CONF-760704-2	1:26782	*See* LA-UR-76-965
CONF-760706-4	1:26036	*See* IS-M-70
5	1:26037	*See* IS-M-71
CONF-760707-2	1:25801	Dep. NTIS, $3.50
CONF-760709-1	1:26473	Dep. NTIS, $3.50
CONF-760710-2	1:26222	*See* K-GD-1479
CONF-760715-1	1:26742	*See* LA-UR-76-1418
CONF-760716-1	1:26666	*See* LA-UR-76-1399
2	1:26667	*See* LA-UR-76-1408
CONF-760721-1	1:26558	*See* UCID-17178
CONF-760726-1	1:26375	*See* MLM-2343(OP)
CONF-760801-2	1:25229	*See* UCRL-77627
CONF-760803-8	1:26211	*See* LBL-4978
CONF-760805-4	1:26398	*See* LA-UR-76-997
5	1:26401	*See* LA-UR-76-1201
6	1:26400	*See* LA-UR-76-1174
16	1:26399	*See* LA-UR-76-1115

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17	1:26397	*See* LA-UR-76-986
18	1:26402	*See* LA-UR-76-1518
CONF-760806-		
1	1:25493	*See* KY-L-831
2	1:25475	*See* K-C-1241
3	1:26462	*See* BNWL-SA-5778
4	1:26463	Dep. NTIS, $4.00
6	1:25470	Dep. NTIS, $3.50
CONF-760810-		
1	1:26340	Dep. NTIS, $3.50
CONF-760812-		
1	1:26266	*See* SAND-76-5428
3	1:26759	*See* BNL-21590
CONF-760813-		
3	1:25465	Dep. NTIS, $3.50
8	1:26284	*See* SAND-76-5370
9	1:26285	*See* SAND-76-5371
CONF-760816-		
2	1:26909	*See* LA-UR-76-892
3	1:26883	*See* UCRL-78036
4	1:26383	*See* SAND-75-6154
5	1:25839	Dep. NTIS, $3.50
6	1:26888	Dep. NTIS, $3.50
7	1:26881	*See* BNL-21311
CONF-760819-		
3	1:26066	*See* SAND-76-5443
4	1:26065	*See* SAND-76-5442
5	1:26058	*See* BNWL-SA-5586
CONF-760820-		
1	1:26566	Dep. NTIS, $3.50
CONF-760821-		
1	1:25561	*See* SAND-76-5291
7	1:25689	*See* SAND-76-5712
CONF-760822-		
1	1:26282	*See* UCRL-77852
4	1:25471	Dep. NTIS, $3.50
7	1:25458	*See* DPSPU-76-30-9
10	1:26223	*See* MLM-2331(OP)
14	1:25477	*See* LA-UR-76-1515
CONF-760826-		
1	1:25262	*See* UCRL-78144
2	1:25253	Dep. NTIS, $3.50
4	1:26260	*See* UCRL-78026
5	1:26562	Dep. NTIS, $4.50
CONF-760827-		
1	1:26382	*See* MLM-2338(OP)
CONF-760831-		
1	1:26136	Dep. NTIS, $3.50
CONF-760901-		
1	1:26210	*See* LBL-4543
CONF-760903-		
1	1:26381	*See* LA-UR-76-623
2	1:25822	*See* LA-UR-76-621
CONF-760905-		
1	1:25802	Dep. NTIS, $4.50
2	1:25853	Dep. NTIS, $4.00
3	1:25871	Dep. NTIS, $4.00
4	1:26059	*See* COO-2733-3
5	1:25803	Dep. NTIS, $4.00
8	1:26348	*See* UCRL-77724(Rev.1)
CONF-760906-		
2	1:25998	*See* SAND-76-5121
5	1:25221	Dep. NTIS, $3.50
CONF-760907-		
1	1:26540	*See* BNL-21314
CONF-760909-		
2	1:25688	*See* SAND-76-5683
CONF-760915-		
1	1:25706	*See* UCRL-77669
CONF-760916-		
1	1:26213	*See* ORO-1797-64
CONF-760919-		
1	1:26418	Dep. NTIS, $3.50
CONF-760920-		
1	1:26160	*See* LA-UR-76-1567
CONF-760921-		
1	1:26352	*See* BNL-21616
CONF-760922-		
2	1:26077	*See* SAND-76-5289
6	1:26078	*See* SAND-76-5290
COO-		
910-41	1:26595	Dep. NTIS, $3.50
0019-4	1:25309	Dep. NTIS, $3.50
1024-55	1:26613	Dep. NTIS, $3.50
1024-56	1:26614	Dep. NTIS, $4.00

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1105-227	1:26373	Dep. NTIS, $5.50
1195-360	1:26730	Dep. NTIS, $4.00
1199-51	1:26429	Dep. NTIS, $4.00
1340-49	1:26423	Dep. NTIS, $4.00
1340-50	1:26424	Dep. NTIS, $4.00
1358-15	1:26653	Dep. NTIS, $3.50
1428-433	1:26709	Dep. NTIS, $4.00
1428-434	1:26710	Dep. NTIS, $4.50
1428-435	1:26715	Dep. NTIS, $3.50
1545-92	1:26370	Dep. NTIS, $5.00
1545-179	1:26716	Dep. NTIS, $3.50
2271-78	1:26717	Dep. NTIS, $3.50
2280-12	1:26921	Dep. NTIS, $4.50
2280-24	1:26922	Dep. NTIS, $3.50
2280-26	1:26751	Dep. NTIS, $4.00
2381-1	1:25697	Dep. NTIS, $4.00
2455-10	1:26425	Dep. NTIS, $3.50
2458-9	1:26752	Dep. NTIS, $3.50
2471-6	1:25872	Dep. NTIS, $4.00
2515-5	1:25873	Dep. NTIS, $3.50
2552-5	1:25719	Dep. NTIS, $3.50
2560-1	1:25582	Dep. NTIS, $8.00
2589-1	1:25610	Dep. NTIS, $4.00
2724-1	1:26221	Dep. NTIS, $3.50
2733-3	1:26059	Dep. NTIS, $4.00
2733-5	1:26343	Dep. NTIS, $3.50
2791-1	1:25979	Dep. NTIS, $4.00
3028-24	1:26231	Dep. NTIS, $3.50
3065-137	1:26724	Dep. NTIS, $3.50
3130TB-215	1:26712	Dep. NTIS, $5.50
3161-37	1:26756	Dep. NTIS, $3.50
3380-23	1:26615	Dep. NTIS, $3.50
3390-27	1:26481	Dep. NTIS, $3.50
COO/2672-		
76/2	1:25646	Dep. NTIS, $3.50
COO/2683-		
76/2	1:25611	Dep. NTIS, $6.00
76/6	1:25612	Dep. NTIS, $3.50
76/7	1:25613	Dep. NTIS, $3.50
CREARE-TN-		
235	1:25874	Dep. NTIS, $4.00
CRES-TR-		
227-2	1:26178	*See* AD-A-011311
DHEW/FDA-		
75-8026	1:26658	*See* PB-241903
DOCKET-50293-		
619	1:25778	Dep. NTIS, $4.00
DOCKET-701701-		
1	1:25457	Dep. NTIS, $9.00
DOT/TES/OCA-		
75/1	1:25982	*See* PB-241764
75/2	1:25983	*See* PB-241765
DOT-TSC-OST-		
75-3	1:25985	*See* PB-248953
DP-		
1392	1:25864	Dep. NTIS, $4.50
1414	1:26755	Dep. NTIS, $3.50
1432	1:25393	Dep. NTIS, $4.50
DP-MS-		
75-119	1:26255	Dep. NTIS, $4.00
76-7	1:25791	Dep. NTIS, $4.00
76-16	1:25854	Dep. NTIS, $3.50
DPSPU-		
76-30-9	1:25458	Dep. NTIS, $3.50
DPST-		
65-302	1:26464	Dep. NTIS, $4.00
72-128-1	1:25507	Dep. NTIS, $3.50
73-128-1	1:25508	Dep. NTIS, $3.50
76-128-5	1:25509	Dep. NTIS, $3.50
Ds-UD-		
1975-1	1:25497	*See* INIS-mf-2070
EGG-		
1183-2336	1:26371	Dep. NTIS, $4.00
EMSL-LV-		
539-6	1:26649	Dep. NTIS, $4.00
ENDF-		
232	1:26737	*See* BNL-NCS-50503
EPA-		
450/2-74-014	1:26447	*See* PB-241807
450/2-74-015	1:26448	*See* PB-241808
450/2-76-006	1:26430	NTIS
450/3-75-016	1:25917	*See* PB-245833
460/3-74-001	1:26019	*See* PB-237208
460/3-74-003	1:26032	*See* PB-232682
520/6-74-006	1:25494	*See* PB-241247

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650/2-74-051	1:26023	*See* PB-237115
650/4-74-021	1:25704	*See* PB-234150
680/4-75/007	1:26475	*See* PB-245598
EPA/GAD-		
1-75-001	1:26438	*See* PB-241476
1-75-002	1:26437	*See* PB-241400
EPRI-SR-		
34	1:25941	NTIS
EQL-Memo-		
17	1:25682	Environmental Quality Lab., Pasadena, CA
ERDA-		
76-10	1:25197	Dep. NTIS, $10.75
76-45-5	1:26657	Dep. NTIS, $4.00
76-88	1:25614	TIC
1536(DRAFT)	1:26564	
ERDA/NASA/19740-		
76/1	1:25560	Dep. NTIS, $7.50
ERDA-tr-		
112	1:26860	Dep. NTIS, $4.00
141	1:25701	Dep. NTIS, $3.50
146	1:26616	Dep. NTIS, $7.75
149	1:26843	Dep. NTIS, $3.50
EUR-		
5205d	1:25775	*See* EURFNR-1286
5274	1:25792	INIS
EURFNR-		
1273	1:25776	Dep. NTIS, $4.00
1286	1:25775	Dep. NTIS, $8.00
EURISOTOP-		
85	1:26344	INIS
FE-		
496-115	1:25206	Dep. NTIS, $4.50
1207-P17	1:25222	Dep. NTIS, $3.50
1212-T-10	1:25254	Dep. NTIS, $9.25
1231-3	1:25285	Dep. NTIS, $6.75
1505-7	1:25223	Dep. NTIS, $4.00
1518-34	1:25513	Dep. NTIS, $4.00
1772-13(Vol.3)	1:25255	Dep. NTIS, $4.50
1772-16	1:25224	Dep. NTIS, $3.50
1773-18	1:25518	Dep. NTIS, $5.50
1790-4	1:25225	Dep. NTIS, $5.00
1792-12	1:25292	Dep. NTIS, $4.00
2006-2	1:25226	Dep. NTIS, $5.00
2033-10	1:25207	Dep. NTIS, $4.50
2201-5	1:25297	Dep. NTIS, $3.50
2229-1	1:25227	Dep. NTIS, $4.00
2307-2	1:25256	Dep. NTIS, $4.00
FEA/B-		
75/656	1:25960	*See* PB-246393
75/657	1:25960	*See* PB-246393
FEA/D-		
76/077	1:25931	*See* PB-251665
76/325	1:25929	NTIS, $4.50
76/341	1:25930	NTIS
FEA/E-		
75/577	1:25946	*See* PB-246025
76/302	1:25989	NTIS, $4.00
FIND-		
50548	1:25779	NTIS
FOA-C-		
20075-A2	1:26753	INIS
G/J-TR-		
66.116-74.01	1:26460	*See* AD-A-010264
GA-A-		
13140	1:25748	Dep. NTIS, $7.50
13461	1:25844	Dep. NTIS, $6.75
13868	1:25762	Dep. NTIS, $7.75
13883	1:26856	Dep. NTIS, $3.50
13896	1:26857	Dep. NTIS, $4.50
GEAP-		
13771-18	1:25763	AT
14029-5	1:25764	AT
14029-7	1:25765	AT
14034-6	1:25875	AT
14045-4	1:25766	AT
14100	1:25767	AT
GEPP-		
211	1:26209	Dep. NTIS, $4.00
GJBX-		
20(76)	1:25388	Dep. NTIS, $10.50
21(76)	1:25389	Dep. NTIS, $3.50
22(76)	1:25390	Dep. NTIS, $4.00
GJO-		
100(76)	1:25391	Dep. NTIS, $5.00
1633-1	1:25389	*See* GJBX-21(76)
1633-2	1:25390	*See* GJBX-22(76)
6344	1:26665	Dep. NTIS, $16.25
GS-C-		
731	1:25954	Branch of Distribution, U.S. Geological Survey, 1200 S. Eads St., Arlington, VA 22202 Free
GURC-		
141	1:25311	*See* NSF-RA-N-74-251
142	1:25371	*See* NSF-RA-N-74-252
HAC-P-		
75-191	1:26286	*See* AD-A-011427
HAC-Ref-D-		
1687	1:26286	*See* AD-A-011427
HASL-		
307	1:26180	Dep. NTIS, $4.00
HEDL-SA-		
851	1:25472	Dep. NTIS, $5.00
856	1:25473	Dep. NTIS, $4.50
936	1:25876	Dep. NTIS, $4.50
1011	1:26124	Dep. NTIS, $4.00
1039	1:26125	Dep. NTIS4.00
HEDL-TI-		
76005	1:26060	Dep. NTIS, $9.00
HEDL-TME-		
74-28	1:25855	AT
76-13	1:26126	Dep. NTIS, $8.00
76-16	1:25768	AT
IA-		
1312	1:25793	INIS
IAEA-R-		
1119-F	1:25733	INIS
IFA-FR-		
128-1975	1:25794	INIS
146-1975	1:25795	INIS
IFA-TR-		
60-1975	1:25796	INIS
IIEQ-		
75-04	1:26436	*See* PB-241355
IIHR-		
155	1:26554	*See* PB-241941
INEL-TR-		
5	1:26663	Dep. NTIS, $4.00
INIS-mf-		
2022	1:26549	INIS
2023	1:26550	INIS
2024	1:26551	INIS
2025	1:26552	INIS
2027	1:25877	INIS
2028	1:26914	INIS
2065	1:25398	INIS
2066	1:25394	INIS
2070	1:25497	INIS
2073	1:26915	INIS
2074	1:25742	INIS
3000	1:26830	INIS
3001	1:26831	INIS
3002	1:26832	INIS
3003	1:26833	INIS
3004	1:26834	INIS
3005	1:26891	INIS
3023	1:25713	INIS
3025	1:25720	INIS
3025	1:25723	INIS
3025	1:25721	INIS
3025	1:25743	INIS
3025	1:25725	INIS
3025	1:25722	INIS
3025	1:25724	INIS
3025	1:25726	INIS
3025	1:25734	INIS
3025	1:25804	INIS
3025	1:25807	INIS
3025	1:25806	INIS
3025	1:25805	INIS
3025	1:25816	INIS
3025	1:25780	INIS
3025	1:25784	INIS
3025	1:25782	INIS
3025	1:25783	INIS
3025	1:25781	INIS
3030	1:26431	INIS
3031	1:25841	INIS
3032	1:25878	INIS

Report No.	Abstract No.	Availability
3038	1:26761	INIS
3039	1:25466	INIS
3041	1:26763	INIS
3042	1:26790	INIS
3043	1:26916	INIS
3046	1:25856	INIS
3047	1:25727	INIS
3060	1:26754	INIS
3065	1:26917	INIS
3067	1:26913	INIS
3070	1:26379	INIS
3071	1:25392	INIS
IPPCZ-		
188	1:26764	NTIS (US Sales Only)
IPPJ-		
206	1:26835	INIS
207	1:26811	INIS
208	1:26892	INIS
209	1:26765	INIS
210	1:26796	INIS
211	1:26812	INIS
212	1:26813	INIS
213	1:26806	INIS
214	1:26836	INIS
IPPJ-T-		
22	1:26876	INIS
23	1:26877	INIS
IS-EMRRI-		
2	1:26559	Dep. NTIS, $6.00
IS-M-		
70	1:26036	Dep. NTIS, $3.50
71	1:26037	Dep. NTIS, $3.50
IS-T-		
611	1:26010	NTIS
708	1:26187	Dep. NTIS, $5.00
719	1:26188	Dep. NTIS, $6.00
721	1:26159	Dep. NTIS, $5.50
ISWS/RI-		
81/75	1:26426	Dep. NTIS, $10.00
ITN-		
101-1975	1:25797	INIS
JAERI-M-		
5829	1:26038	INIS
5829	1:26047	INIS
5829	1:26073	INIS
5829	1:26049	INIS
5829	1:26048	INIS
5829	1:26345	INIS
5829	1:25450	INIS
5829	1:25451	INIS
5829	1:26127	INIS
5829	1:26152	INIS
5829	1:26153	INIS
5829	1:26154	INIS
5829	1:26155	INIS
5829	1:26130	INIS
5829	1:26129	INIS
5829	1:26137	INIS
5829	1:26128	INIS
5955	1:25728	INIS
5987	1:25735	INIS
5997	1:26736	INIS
5999	1:26867	INIS
6025	1:26868	INIS
6026	1:26797	INIS
6027	1:26869	INIS
6028	1:26870	INIS
6042	1:26779	INIS
6050	1:26871	INIS
6072	1:26865	INIS
6094	1:26131	INIS
6096	1:26794	INIS
6102	1:26858	INIS
6106	1:25474	INIS
6107	1:25857	INIS
6113	1:25828	INIS
6143	1:26798	INIS
6144	1:26780	INIS
6166	1:26781	INIS
6167	1:26814	INIS
6171	1:26766	INIS
6178	1:26767	INIS
6181	1:26119	INIS
6182	1:26120	INIS

Report No.	Abstract No.	Availability
K-C-		
1241	1:25475	Dep. NTIS, $4.00
K-GD-		
1479	1:26222	Dep. NTIS, $4.00
K-TL-		
524(Pt.1)	1:25395	Dep. NTIS, $3.50
524(Pt.2)	1:25396	Dep. NTIS, $4.00
KFKI-		
74-68	1:25879	INIS
KURRI-TR-		
123	1:25736	INIS
123	1:25744	INIS
123	1:25749	INIS
123	1:25737	INIS
123	1:25858	INIS
123	1:25880	INIS
123	1:25860	INIS
123	1:25859	INIS
123	1:25817	INIS
123	1:25819	INIS
123	1:25820	INIS
123	1:25821	INIS
123	1:25818	INIS
123	1:25769	INIS
KY-L-		
831	1:25493	Dep. NTIS, $4.00
LA-		
6162-MS	1:26908	Dep. NTIS, $3.50
6189-MS	1:26893	Dep. NTIS, $4.00
6252	1:25476	Dep. NTIS, $5.00
6254-MS	1:26263	Dep. NTIS, $3.50
6265-MS	1:26264	Dep. NTIS, $3.50
6335-PR	1:26660	Dep. NTIS, $4.50
6356-MS	1:26372	Dep. NTIS, $3.50
6358-C	1:25443	Dep. NTIS, $5.50
6362-MS	1:26882	Dep. NTIS, $3.50
6393-MS	1:26768	Dep. NTIS, $3.50
6410-MS	1:26380	Dep. NTIS, $3.50
6417-MS	1:26396	Dep. NTIS, $3.50
6420-MS	1:26894	Dep. NTIS, $3.50
6428-MS	1:26923	Dep. NTIS, $3.50
6449-MS	1:26924	Dep. NTIS, $3.50
LA-tr-		
76-1	1:26365	Dep. NTIS, $3.50
76-2	1:26366	Dep. NTIS, $3.50
LA-UR-		
75-1486	1:26289	Dep. NTIS, $3.50
76-621	1:25822	Dep. NTIS, $3.50
76-623	1:26381	Dep. NTIS, $3.50
76-727	1:26229	Dep. NTIS, $3.50
76-830	1:26743	Dep. NTIS, $3.50
76-892	1:26909	Dep. NTIS, $3.50
76-899	1:26872	Dep. NTIS, $3.50
76-965	1:26782	Dep. NTIS, $3.50
76-986	1:26397	Dep. NTIS, $3.50
76-997	1:26398	Dep. NTIS, $3.50
76-1115	1:26399	Dep. NTIS, $3.50
76-1131	1:26145	Dep. NTIS, $3.50
76-1134	1:26144	Dep. NTIS, $3.50
76-1136	1:26910	Dep. NTIS, $3.50
76-1150	1:26039	Dep. NTIS, $3.50
76-1174	1:26400	Dep. NTIS, $3.50
76-1178	1:26368	Dep. NTIS, $3.50
76-1183	1:26731	Dep. NTIS, $3.50
76-1197	1:26713	Dep. NTIS, $3.50
76-1201	1:26401	Dep. NTIS, $3.50
76-1203	1:26878	Dep. NTIS, $3.50
76-1297	1:26911	Dep. NTIS, $3.50
76-1298	1:26146	Dep. NTIS, $3.50
76-1335	1:26474	Dep. NTIS, $4.00
76-1383	1:26740	Dep. NTIS, $3.50
76-1399	1:26666	Dep. NTIS, $3.50
76-1408	1:26667	Dep. NTIS, $3.50
76-1417	1:26560	Dep. NTIS, $3.50
76-1418	1:26742	Dep. NTIS, $3.50
76-1432	1:25861	Dep. NTIS, $3.50
76-1515	1:25477	Dep. NTIS, $3.50
76-1518	1:26402	Dep. NTIS, $3.50
76-1535	1:26138	Dep. NTIS, $3.50
76-1561	1:25615	Dep. NTIS, $4.00
76-1567	1:26160	Dep. NTIS, $3.50
LBL-		
3315	1:26837	INIS
4452	1:26879	Dep. NTIS, $3.50
4473	1:26880	Dep. NTIS, $3.50

Report No.	Abstract No.	Availability
4490	1:26011	Dep. NTIS, $7.50
4498	1:25228	Dep. NTIS, $5.50
4543	1:26210	Dep. NTIS, $4.00
4696	1:26362	Dep. NTIS, $3.50
4717	1:26567	Dep. NTIS, $8.00
4826	1:26369	Dep. NTIS, $3.50
4978	1:26211	Dep. NTIS, $3.50
4981	1:26074	Dep. NTIS, $5.00
5200	1:26838	Dep. NTIS, $3.50
5201	1:26839	Dep. NTIS, $3.50
LRD-		
10/75	1:25478	INIS
LSU-SG-		
73-01	1:26486	Louisiana State Univ., Baton Rouge
LURI-		
1974-02	1:26465	INIS
MATT-		
1191	1:26783	Dep. NTIS, $4.00
1227	1:26769	Dep. NTIS, $3.50
1242	1:26815	Dep. NTIS, $3.50
1246	1:26816	Dep. NTIS, $4.50
1257	1:26873	Dep. NTIS, $3.50
1271	1:26817	Dep. NTIS, $3.50
MERC/TPR-		
76/3	1:25370	Dep. NTIS, $4.00
76/4	1:25310	Dep. NTIS, $3.50
MHSMP-		
76-13	1:26403	Dep. NTIS, $3.50
76-15B	1:26404	Dep. NTIS, $3.50
76-17D	1:26405	Dep. NTIS, $3.50
76-17-O	1:26406	Dep. NTIS, $3.50
76-17P	1:26407	Dep. NTIS, $3.50
76-17R	1:26408	Dep. NTIS, $3.50
76-17T	1:26409	Dep. NTIS, $3.50
76-17V	1:26410	Dep. NTIS, $3.50
76-17W	1:26199	Dep. NTIS, $3.50
76-17X	1:26411	Dep. NTIS, $3.50
76-17Y	1:26412	Dep. NTIS, $3.50
76-17Z	1:26413	Dep. NTIS, $3.50
MLM-		
2280	1:26414	Dep. NTIS, $3.50
2331(OP)	1:26223	Dep. NTIS, $3.50
2334(OP)	1:26156	Dep. NTIS, $3.50
2338(OP)	1:26382	Dep. NTIS, $3.50
2343(OP)	1:26375	Dep. NTIS, $3.50
MS-		
147U001	1:26793	*See* AD-A-010494
N-		
75-20291	1:26017	NTIS, $9.25
75-20292	1:26018	NTIS, $10.00
75-20336	1:26014	NTIS, $10.50
75-20417	1:26686	NTIS, $3.75
75-20495	1:26259	NTIS, $3.75
75-20830	1:25538	NTIS, $3.75
75-20919	1:26422	NTIS, $4.25
75-22242	1:26675	NTIS, $3.25
75-22979	1:26681	NTIS, $4.25
75-30863	1:26719	NTIS, $3.75
75-30953	1:26676	NTIS, $3.25
75-30991	1:26684	NTIS, $3.75
75-31964	1:26669	NTIS, $4.25
NASA-CR-		
2525	1:25538	*See* N-75-20830
132606	1:26422	*See* N-75-20919
134793	1:26259	*See* N-75-20495
135012	1:25560	*See* ERDA/NASA/19740-76/1
137525	1:26017	*See* N-75-20291
137526	1:26018	*See* N-75-20292
142726	1:26681	*See* N-75-22979
143319	1:26684	*See* N-75-30991
143366	1:26676	*See* N-75-30953
143381	1:26719	*See* N-75-30863
NASA-TM-X-		
3054	1:26022	
70883	1:26675	*See* N-75-22242
NASA-TT-F-		
16219	1:26686	*See* N-75-20417
16545	1:26669	*See* N-75-31964
NEDO-		
10905-2	1:25881	
NGI-		
74605-2	1:25842	INIS
NLCO-		
1132	1:25479	Dep. NTIS, $5.00
1134	1:26040	Dep. NTIS, $4.00
NP-		
20499/P1	1:25364	Bureau of Land Management, Washington, DC
20499/P2	1:25365	Bureau of Land Management, Washington, DC
20499/P3	1:25366	Bureau of Land Management, Washington, DC
20587	1:25373	Dept. of Transportation, Washington, DC
20944	1:25678	GPO, $2.00
20946	1:26041	Climax Molybdenum Co., New York, NY
20962	1:25882	National Science Foundation, Washington, DC
20978	1:25679	California Div. of Oil and Gas, Sacramento, $2.50
21009	1:25965	TIC
NSF-RA-N-		
74-224	1:25942	National Science Foundation, Washington, DC
74-241	1:25367	National Science Foundation, Washington, DC
74-251	1:25311	National Science Foundation, Washington, DC
74-252	1:25371	National Science Foundation, Washington, DC
76-084	1:25980	NTIS
NSF/RANN/SE/AER-		
74-17521-A01/FR/75/2	1:25572	*See* PB-242167
NTIS/PS-		
75/464	1:25376	NTIS, $25.00
75/710	1:25363	NTIS, $25.00
NU-		
2512-8	1:26212	Dep. NTIS, $3.50
NVO-		
1253-7	1:26661	Dep. NTIS, $4.00
1253-8	1:26662	Dep. NTIS, $5.00
ORNL-		
5115	1:25750	Dep. NTIS, $5.00
5131	1:26075	AT
5160	1:26650	Dep. NTIS, $7.75
5162	1:25770	AT
ORNL/CSD-		
8	1:26925	Dep. NTIS, $4.00
ORNL/CSD/TM-		
2	1:26750	Dep. NTIS, $3.50
ORNL-MIT-		
138	1:25788	Dep. NTIS, $4.50
219	1:26265	Dep. NTIS, $4.50
222	1:25298	Dep. NTIS, $4.00
230	1:26176	Dep. NTIS, $4.00
ORNL/NUREG/TM-		
10	1:25883	Dep. NTIS, $4.50
14	1:25884	Dep. NTIS, $5.00
18	1:25808	Dep. NTIS, $4.50
ORNL/TM-		
4975	1:26076	Dep. NTIS, $4.00
5091	1:25459	Dep. NTIS, $4.00
5329	1:26061	AT
5333	1:26874	Dep. NTIS, $4.00
5399	1:26062	AT
5403	1:26063	AT
5422	1:26189	Dep. NTIS, $4.00
5429	1:26770	Dep. NTIS, $4.00
5505	1:26190	Dep. NTIS, $3.50
5532	1:25198	Dep. NTIS, $4.00
5538	1:25460	AT
5547	1:25461	Dep. NTIS, $5.00
ORNL-tr-		
2948	1:26654	Dep. NTIS, $4.00
4101	1:26468	Dep. NTIS, $4.50
4103	1:26659	Dep. NTIS, $3.50
4109	1:26494	Dep. NTIS, $3.50
4110	1:26569	Dep. NTIS, $4.00
4114	1:26453	Dep. NTIS, $3.50
4161	1:26587	Dep. NTIS, $3.50
4170	1:26202	Dep. NTIS, $3.50
4172	1:26200	Dep. NTIS, $3.50
4180	1:25452	Dep. NTIS, $4.00
4182	1:25717	Dep. NTIS, $3.50
4183	1:26161	Dep. NTIS, $3.50
4185	1:25718	Dep. NTIS, $3.50
4199	1:26214	Dep. NTIS, $3.50

Report No.	Abstract No.	Availability
ORO-		
1797-64	1:26213	Dep. NTIS, $3.50
2690-16	1:26568	Dep. NTIS, $4.50
3106-60	1:26232	Dep. NTIS, $4.00
3443-60	1:26926	Dep. NTIS, $3.50
3728-9	1:26645	Dep. NTIS, $3.50
3941-30	1:26606	Dep. NTIS, $3.50
3992-265	1:26725	Dep. NTIS, $3.50
3992-266	1:26760	Dep. NTIS, $4.00
4493-3	1:26553	Dep. NTIS, $3.50
4918-8	1:25571	Dep. NTIS, $6.00
OUEL-		
1097/74	1:26014	*See* N-75-20336
PATENTS-CA-		
972482	1:25812	
972874	1:26903	
972875	1:25813	
973644	1:26079	
973684;	1:25455	
974190	1:25446	
974667	1:25815	
974668	1:25759	
974669	1:25814	
PATENTS-FR-		
2,236,786/A/	1:25483	
2,238,537/A/	1:25810	
2,240,046/A/	1:25454	
2,240,187/A/	1:25453	
2,241,850/A/	1:25774	
2,241,852/A/	1:25829	
PATENTS-NL-		
7,409,872/A/	1:25773	
7,504,015/A/	1:25485	
7,505,595/A/	1:25444	
7,507,452/A/	1:25445	
PATENTS-US-		
A583,374	1:25672	
A590,980	1:25673	
3,629,996	1:25276	
3,798,308	1:25209	
3,803,804	1:25277	
3,891,486	1:25676	
3,892,128	1:26386	
3,895,520	1:26387	
3,896,412	1:26388	
3,896,413	1:26389	
3,896,668	1:26390	
3,898,877	1:26391	
3,899,768	1:26664	
3,900,733	1:26393	
3,900,824	1:26394	
3,900,826	1:26392	
3,923,596	1:25823	
3,923,634	1:25258	
3,923,646	1:25328	
3,924,680	1:25201	
3,924,827	1:25692	
3,924,966	1:25691	
3,925,042	1:25230	
3,925,191	1:25329	
3,926,575	1:25210	
3,926,590	1:25708	
3,926,775	1:25259	
3,926,783	1:25330	
3,930,405	1:26355	
3,930,537	1:26273	
3,930,639	1:26350	
3,930,988	1:25346	
3,931,395	1:25511	
3,931,488	1:26420	
3,932,014	1:26356	
3,933,201	1:25312	
3,933,249	1:26275	
3,933,416	1:26274	
3,934,650	1:25372	
3,935,545	1:26293	
3,937,966	1:26367	
3,939,695	1:26353	
3,940,711	1:26294	
3,941,413	1:25836	
3,941,566	1:26278	
3,941,586	1:26277	
3,941,716	1:25326	
3,946,239	1:26576	
3,946,645	1:26351	
3,946,942	1:25503	
3,947,320	1:25825	
3,947,321	1:25837	
3,947,675	1:26357	
3,948,320	1:25244	
3,948,617	1:25281	
3,948,761	1:25327	
3,949,049	1:25463	
3,952,724	1:25649	
3,952,947	1:25616	
3,953,569	1:25400	
3,953,731	1:25447	
3,954,097	1:25651	
3,954,654	1:25464	
3,956,902	1:25693	
3,957,022	1:26021	
3,957,109	1:25653	
3,957,444	1:26027	
3,957,445	1:26026	
3,958,062	1:25655	
3,958,553	1:25652	
3,958,554	1:25648	
3,959,056	1:25650	
3,960,135	1:25654	
3,960,136	1:25671	
3,960,322	1:25656	
3,961,615	1:26025	
3,962,877	1:25702	
3,963,381	1:25378	
3,963,415	1:25293	
3,963,416	1:26360	
3,963,426	1:25246	
3,963,457	1:25245	
3,963,463	1:25709	
3,963,600	1:25340	
3,963,994	1:26310	
3,964,003	1:26309	
3,964,155	1:25551	
3,964,264	1:25319	
3,964,341	1:25889	
3,964,464	1:25675	
3,964,544	1:25320	
3,964,545	1:25317	
3,964,546	1:25313	
3,964,547	1:25314	
3,964,548	1:25315	
3,964,551	1:25318	
3,964,552	1:25321	
3,964,558	1:25316	
3,964,678	1:25637	
3,964,927	1:25893	
3,964,932	1:25894	
3,965,242	1:25282	
3,965,326	1:26279	
3,965,357	1:26346	
3,965,359	1:25505	
3,965,411	1:26281	
3,965,439	1:26312	
3,965,440	1:26311	
3,965,683	1:25566	
3,965,972	1:25638	
3,965,983	1:25322	
3,966,261	1:25295	
3,966,262	1:25294	
3,966,447	1:26315	
3,966,448	1:26316	
3,966,491	1:25895	
3,966,492	1:25896	
3,966,493	1:25897	
3,966,494	1:25898	
3,966,495	1:25899	
3,966,499	1:25552	
3,966,541	1:25639	
3,966,560	1:25341	
3,966,561	1:25203	
3,966,582	1:25248	
3,966,583	1:25247	
3,966,584	1:25205	
3,966,585	1:25204	
3,966,586	1:25335	
3,966,587	1:25334	
3,966,588	1:25336	
3,966,634	1:25249	
3,967,211	1:26318	
3,967,212	1:26314	

Report No.	Abstract No.	Availability
3,967,213	1:26317	
3,967,214	1:26313	
3,967,680	1:25323	
3,967,976	1:25900	
3,967,978	1:25901	
3,968,023	1:25342	
3,968,052	1:25251	
3,968,455	1:26323	
3,968,456	1:26322	
3,968,572	1:25384	
3,968,593	1:26016	
3,968,653	1:25777	
3,969,093	1:25711	
3,969,094	1:25712	
3,969,185	1:25826	
3,969,186	1:25827	
3,969,187	1:25838	
3,969,492	1:25710	
3,969,684	1:26327	
3,969,685	1:26328	
3,969,686	1:26324	
3,969,687	1:26325	
3,969,688	1:26326	
3,969,860	1:26002	
3,970,142	1:26006	
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